

SLOW DESIGN IN CHINESE SU XIU EMBROIDERY FOR APPAREL: APPLYING SILK,  
COTTON, AND WOOL FLOSSES TO SILK AND COTTON FABRICS WITH PHYSICAL  
RESIST DYEING TECHNIQUES USING NATURAL DYE

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## **Abstract**

This study was based on the concept of slow design, proposed after the slow food movement. The idea of slowing down production processes and increasing product quality and value suggests an antidote to the fast cycle of the fashion industry. Slow design supports two principals, inheriting tradition and maintaining eco-efficiency, which guided this project. Inheriting tradition is an expression that explores ways to sustain lost art and traditional heritage in our daily lives, as well as develop products that establish personal meaning for the consumer. Maintaining eco-efficiency of product production involves utilization of eco-friendly materials and sustainable approaches to aid in developing a healthier and cleaner ecosystem.

The overall goal of this design research was to celebrate and sustain the spiritual and material civilization of the Chinese culture by creating a modern artistic interpretation of Chinese traditional arts using an environmentally conscious approach that was applicable to apparel design. This research created modern surface design on a group of garments from traditional Chinese Su Xiu embroidery, physical resist techniques, and natural dyes.

This practice-based research utilized the paradigm of naturalistic inquiry to guide the stages of this project. A progressive design process was adopted in response to the unexpected events in the final artifact development. In the design exploration stage, a color library was created to provide the color story for the final artifacts. Basic Su Xiu embroidery stitches and traditional physical resist techniques were sampled with selected flosses and fabrics. Various samples were critiqued and analyzed to develop three unique techniques from characteristics of traditional Chinese Su Xiu embroidery, physical resist techniques (Zha Jiao, Feng Jiao, pole-wrapping, and Jia Xie), using natural dyeing techniques with woad and madder. Natural dye findings included using madder to overdye woad to adjust or reverse colors and that woad overpowered the effects of iron and acid premordants. The outcome resulted in a water-inspired series of three garments that showed evidence of simplified traditional techniques with reduced production time, energy, and dyeing material while encompassing elements of traditional art using a modern aesthetic. The designs and process were presented in a public exposition.

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## **Chapter 1 - Introduction**

As our world becomes more polluted, sustainable approaches in various aspects of society are gaining popularity. As a result, the movement of slow design has surfaced in the recent years. The concept suggests a slower way of living and rekindling the relationship between the old and the new. It also counteracts the fast-paced system of the fashion industry. Ever since western industrialization, fashion is more accessible due to mass markets, is produced faster, and is often treated as disposable products. Synthetic dyes, popularized in the 1950s, quickly replaced the use of natural dyes in the textile industry. Thus, our environment started to deteriorate due to increasing stresses resulting in irreversible consequences of pollution. Due to the current practices of economic globalization, modern day people are placing less importance on their cultural traditions and arts. Thus, our society is advancing forward at the expense of losing valuable cultural traditions and arts.

China has been known for its ancient civilization and rich culture; however, many of the arts and crafts are facing decline and extinction today due to the increasingly impactful phenomenon of globalization, mass marketing, and synthetic dye industry. Although the government makes effort to support the development and sustainability of its traditional culture, it still faces the challenge of appropriately introducing this aspect into our everyday living. Su Xiu, from Jiangsu Province, represents the leading embroidery category in China. Su Xiu in China is currently limited to artistic home décor and small apparel accessory products. The Western fashion world has utilized Chinese embroidery on apparel through application of machine embroidery, which captures only a part of this fine art. Revolutionary advancement in the art of hand embroidered Su Xiu is limited and slow in the area of apparel design.

My interests were in the application of Chinese traditional art to surface design. There has been little research or application of Chinese embroidery, Su Xiu, beyond the traditional method of stitching pre-dyed silk floss onto silk fabric. My aim was to stitch undyed silk, cotton, and wool flosses onto silk and cotton fabrics, and then apply color with natural dyes. I was also interested in Chinese physical resist dyeing techniques and ways to include both physical resist patterns and embroidery to the design of contemporary apparel. My hometown, Nantong, is famous for its embroidery by the

famous embroidery artist, Shen Shou, and is also known for its rich history in the vast textile industry. A variety of physical resist methods in the dyeing process are seen on different textiles in Chinese history. When I was exposed to the slow design principle of inheriting tradition, it was natural for me to consider designing a project focusing on traditional Chinese embroidery and dyeing techniques of which I am acquainted with through study and my childhood upbringing. As I gained more knowledge of sustainable approaches in the fashion industry, I was inspired by the principal of maintaining eco-efficiency in slow design philosophy. Thus, eco-friendly natural dye became another element in this creative design research.

### **Purpose and Objectives of the Study**

The overall purpose of this research was to celebrate and sustain the spiritual and material civilization of the Chinese culture by searching for a modern artistic interpretation of Chinese embroidery using an environmentally conscious approach that is applicable in apparel. The aim of this research was to create modern surface design from traditional Chinese techniques of embroidery, physical resist, and natural dye, and to apply the techniques to textiles to create apparel designs. Guiding concepts and objectives included:

1. Research traditional Chinese techniques of embroidery, physical resist, and natural dyes.
2. Research traditional Chinese apparel design elements and modern apparel forms.
3. Integrate the principals of slow design by exploring, utilizing, and reinventing elements of traditional Chinese traditional embroidery, Su Xiu, physical resist techniques, and use of natural dyes.
4. Critique of sample pieces treated with various embroidery and dyeing techniques by major professor and committee members.
5. Develop a group of apparel art forms through illustrations based on the newly developed techniques by fusing both modern and traditional Chinese design elements. Move select illustrations to construction.

6. Evaluation of group through critique of design against concepts of slow design and aesthetics.

7. Finally, exposition of the collection in a public venue as well as submitting for juried review.

## **Chapter 2 - Contextual Review**

### **Background**

#### ***Slow Design***

The Slow Food Movement founded by Carlo Petrini in Italy in 1986 has ignited a movement that is applicable to other production and consumption sectors (Fletcher, 2008). It was an idea that relates food and pleasure with awareness and responsibility. The movement supports biodiversity over standardization, recognizes consumers' need for information, and aims to protect cultural identities related to food (Fletcher, 2008). The Slow Food Movement indicates that consumers are willing to invest in what is scarce, customized and carefully made (Fletcher, 2008). Thus, the slow movement provides an alternative framework for sustainable design.

According to Alastair Faud-Luke (2005), the goal of slow design theory is to consider and balance the trinity of individual, socio-cultural and environmental well-being. Slow designers design for the people as opposed to profit. Ultimately, its goal is to slow down consumption and encourage a less materialistic way of living (Faud-Luke, 2005). Faud-Luke (2005) also noted that slow design should be adopted as a process that encompasses emotion, information, and observation, while also encouraging the “re-kindling of individual and social-cultural imagination that has atrophied with ready-made materialism” (“The Politicization of Slow Design,” para.1).

#### ***Slowing Down Fashion***

The apparel and textile industry has been impacting societies globally since the start of Silk Road. It is now the largest field that employs one-sixth of the world's population (Brown, 2010). In the past 15 years, the fashion industry has become faster in production and cheaper in pricing (Brown, 2010). The advancement in globalization has created vast outsourcing of manufacturing that in turn stimulated growth in competition in the fashion industry. As a result, fashion products have evolved to be more disposable than ever. The majority of clothing in one's closet are most likely low quality with little keepsake value. Vast consumption is evident with clothing sales increasing 60% in the last ten years (Black, 2008).

Fast fashion is a term that has become familiar to many in its use to describe the phenomenon that designs travel from runway to store in very short time (Fletcher, 2007). It is not just about the speed but also about the labor, capital, and natural resources (Fletcher, 2007). These are all factors that contribute to the negative side effects of the industry that strives to maximize profit. Today, the fashion industry is frequently outsourcing internationally. Manufacturing of textiles and apparel has been sped up to gain higher productivity and more profit. Often, these benefits are achieved through violation of laborers' working rights and laws, such as child labor, overtime hours, and poor working conditions. The dark side of our industrialized world was already noticeable. The Italian designer Claudia Dona wrote in *Design after modernism* that "we live in a world overflowing with our own productions, a world which objects besiege us, suffocate us, and very often distance us from one another both physically and mentally...they make us forget how to feel, to touch, to think" (Dona, 1988, p. 158). However, fast is not free. Labor, natural resources, as well as our entire ecosystem are the costs. The fashion cycle today has become a malicious cycle that is reaching its limit (Faud-Luke, 2005). On the macro level, it is a major contributor to global warming (Brown, 2010). As consumers and producers of the mass market, we are guilty of sweatshops and child labor exploitations in this industry as we make purchases and demand fast fashion (Brown, 2010).

Today, the industry is slowly gaining understanding to the urgency of sustainability. Thus, from the slow movement ideology, the term and concept of slow fashion has become more familiar. Kate Fletcher (2007), the renowned eco-textile consultant and author, writes "it's time to slow down and consider the true cost of choosing quantity over quality" (p. 61). Quality fashion usually cannot be achieved without a high price tag but expectations are that it will last twice as long, or more. Further, quality fashion may prevent consumers from buying less expensive and cheaply made products that are frequently disposed (Fletcher, 2008). Fletcher (2008) also suggested, the core to slow fashion is "balancing the speed and rhythm of use" in order to achieve quality (p.173). She further explained that slow fashion offers quality, workmanship, and value at a price (Fletcher, 2008). If one pays more for slow fashion that would last much longer than cheaply made products, no economic loss will occur

when this industry halves its material use by eliminating unnecessary waste (Fletcher, 2008). However, it is important to note that the idea of slow design is not an antidote to fast fashion but focuses on the well-being of the community and ecosystem (Fletcher, 2007).

Fletcher (2008) finds slow fashion to be "about designing, producing, consuming and living better...combining ideas about a sense of nature's time (of regenerating cycles and evolution), culture's time (of the value of traditions and wisdom), as well as the more common timeframes of fashion and commerce. Its emphasis is on quality (of environment, society, working conditions, business, products, etc.)" (p. 173). Sandy Black (2008), author of *Eco-chic: The fashion paradox*, explains slow fashion on a more practical note, in which she states that it should incorporate design with intelligent and innovative choices of materials for minimal impact and waste, aesthetic, functional and emotional value, and concern for the entire life cycle of the product.

Slow design is more complex than just a matter of speed. Alastair Faud-Luke (2005) studied several expressions that describe the approaches to this idea. For the purpose of this project, I will focus on two aspects of the expressions he discussed: inheriting tradition and maintaining eco-efficiency.

### ***Expression of Tradition***

One of the major expressions of slow design that has been quickly adopted is tradition. Inheriting traditional design involves the use of artistic craft from certain regions or cultures (Faud-Luke, 2005). While the designer, whether inside or outside of the culture, understands the local technology in production, he/she evolves or reinterprets this traditional knowledge through modern day living.

Even with the mass production we have today, small-scale handcraft techniques still hold an important place in this industry (Black, 2008). Often, design inspirations come from diverse cultures and subcultures around the world. The interchange of information constantly provides ideas for the fashion industry. Richard Florida posed an economic imperative in *The rise of the creative class* stating that "human creativity is the ultimate economic resource" and "the ability to come up with new ideas and better ways of doing things is ultimately what raises productivity and thus living standards" (Black, 2008, p. 53). For instance, Pierre Cardin traveled to Nantong, China in the 1990s to

research traditional Chinese embroidery. During the visit, he recruited several skilled local embroidery artists to his company who assisted in developing his collection featuring new embellishment (Y. Pu, personal communication, July 1, 2007). Designs of tradition often will stand the test of time in both physical and social contexts (Faud-Luke, 2005). These designs of tradition benefit not only the individual but also the social, cultural, and natural environments of our world.

### ***Expression of Eco-efficiency***

In the expression of tradition Faud-Luke (2005) incorporated what he calls a closed-loop production system, whereby the raw materials utilized are recycled or returned to nature through various approaches. The expression of eco-efficiency is closely related to these approaches through ecological design. Similarly, this expression is concerned with the philosophy of cradle-to-cradle, originally posed by McDonough and Baungart (2002). It is the reuse of material, use of less material, and use of less energy to support green production processes (Faud-Luke, 2005). Eco-efficiency would also slow down the production of pollution and habitat destruction that would cause negative effects on both humans and animals.

Ever since the 1960s, the world has become conscious of the lack of resources in our environment caused by globalization and consumerism (Faud-Luke, 2005). The western world consumes 80% of the earth's resources to sustain only 20% of world's population (Faud-Luke, 2005). Equilibrium has been lost while we have disrespected our mother nature. Further, chemicals used in production have heavily polluted our environment. The depletion of the stratospheric ozone layer due to emissions of chlorofluorocarbons and climate change due to emissions of CO<sub>2</sub> are all evidences of casualty (Heine, 2007). In addition, countries that lack adequate working conditions, environmentally conscious policies, and responsible manufacturing in the apparel industry often pose threats to workers' living environments and their health when harmful chemicals are used for dyeing and printing (Fletcher, 2008). Eco-efficiency in design is ultimately attempting to create a higher quality of life.



### *Slow Fashion Designers*

Fashion is often seen as a form of art. However, art today also has changed by the current understanding and actions of the fashion industry. Writer and critic, Suzi Gablik, noted in the early 1990s that “our thinking about art [has become conditioned] to the experience at the expense of others, such as community, for example, or ritual (Cline, 1997)” (Fuad-Luke, 2005, “Design in Crisis?,” para. 3). Designers’ designs are becoming increasingly materialistic and profit oriented. Luckily, as the slow design movement diffuses through the fashion industry, designers are slowly positioning themselves in the slow fashion market to promote sustainability. Many of them are creating designs in communities or regions that possess rich culture and long-practiced crafts.

Natalie Chanin founded the lifestyle company, Alabama Chanin. Growing up in Florence, Alabama, Chanin is heavily influenced and inspired by her culture and intends to inherit and develop the traditional quilting craft of the area while providing local artisans with job opportunities (Brown, 2010). In 2000, Chanin started Project Alabama, known for its decorative hand-sewn embroidery, patchwork, reverse-appliqué, and other innovative embellishments (Brown, 2010) (Figure 2.1). Alabama Chanin, founded in 2007, produces limited-edition products of women's and men's apparel, jewelry, and home furnishing with recyclable material; the process focuses on slow design and sustainability (Clark, 2008). To focus on slow design and sustainability, her couture garments and other products are hand-sewn from old t-shirts, used clothing, as well as bulk yardage, with limited fabric waste in the production process (Green, 2008). Clark (2008) noted that “Buying these clothing is an investment, which distinguish them as a new form of couture—new in attempting to bring an ethical consciousness but traditional in being custom-made by hand, for individual clients” (p. 436-437). While selling her products through high-end retailers, Chanin also organizes workshops and story-telling sessions to share the knowledge of the crafts and culture in Florence, Alabama (Brown, 2010). Chanin (2007) believes “it’s essential that we respect sanctity of our traditions and skilled workers who keep them alive” (p.184). Through these sustainable fashion design strategies, “Alabama Chanin creates garments that are intended to last, to be cherished, and to build their own cultural memories” (Clark, 2008, p. 437).

Figure 2.1 Design by Alabama Chanin.<sup>1</sup>



Like Chanin, Carla Fernandez, the founder of the Taller Flora label, also focuses on bringing fading crafts back to life while creating innovative apparel that is relevant to our modern day living (Figure 2.2). Growing up in northern Mexico, Fernandez traveled to many richly cultured areas with her anthropologist father (Brown, 2010). Under such influence, she became inspired by the different traditional clothing and items and adopted interests in the way these clothes were made (Brown, 2010). Fernandez has been traveling with her mobile fashion lab, Taller Flora, to various indigenous areas in Mexico to learn the traditional dressmaking while offering reasonable wages for the local artisans to produce her line (Brown, 2010).

Fernandez believes that “only radical contemporary design will prevent the extinction of craftsmanship” (Brown, 2010, p. 50). With this idea, she has developed award-winning collections that showcased traditional Mexican inspired apparel that reinterprets the use of geometric shapes under the modern context (Brown, 2010). She bases her creation on geometric patterns and shapes of the folk garments while exploring

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<sup>1</sup>From website <http://www.alabamachanin.com>

traditional techniques, such as weaving, embroidery, and pleating (Taller Flora, 2006). Taller Flora today has established workshops where artisans and designers can learn and interchange knowledge and ideas to create new products while working for the Department of Folk and Indigenous Cultures of the National Council for Culture and the Arts and various non-governmental organizations that support sustainability (Taller Flora, 2006).

Figure 2.2 Designs by Taller Flora.<sup>2</sup>



Alabama Chanin and Taller Flora are examples of clothing companies in which slow fashion is applied in expression of tradition and eco-efficiency. Increasing numbers of designers alike are on the rise while bringing and promoting traditional design elements and ideology to the globalized apparel and textile industry. Similar to this group of designers, this study attempts to express a personal design aesthetic by utilizing the slow design expressions of tradition and eco-efficiency through the influence of my Chinese heritage.

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<sup>2</sup>From website <http://ecofashionworld.com>

## **Inheriting Tradition**

### ***Chinese Embroidery***

Embroidery is one of the most ancient national crafts in China. The earliest Chinese embroidery dates back thousands of years and has been through various advancements and diversification in its technique. The oldest embroidery fragments were discovered on a bronze drinking vessel from a Shang Period (1600-1150 B.C.) tomb in Anyang, Henan Province (Lin, 2006). The origin of Chinese embroidery is multifaceted. Embroidery is an art that emerges from life and essentially represents spiritual and material civilization. Chinese embroidery has two stages in its development. The first stage is family in which one embroiders to meet self-need or self-fulfillment. The second stage is the embroidery workshop and factory where the business environment brings the embroidered art form to maturity (Zhang, 2004). Ever since the unity of China by the time of Qin and Han dynasties (256-206 B.C.), Chinese cultures were able to merge and sustain along with diverse religions and philosophies. However, the ideologies adopted from other cultures also strongly reflected in the development of Chinese embroidery throughout history.

In the Warring States Period (525-250 B.C.), embroidery techniques were already sophisticated, and the embroidery products obtain both functional and decorative value (Geng, 2010). Embroidery from the Warring States Period often depicted the national symbols of the dragon and phoenix (Figure 2.3). During the Han dynasty (206 B.C. - 220 B.C.), embroidery took on a more elaborate, luxurious, and colorful appearance on not only garments but also home décor items (Geng, 2010). Artifacts from the Mawangdui tomb in Changsha, Hunan Province, reflected this elaborate style often in forms of cloud and animal motifs (see Figure 2.4).

Figure 2.3 Dragon, phoenix, and tiger embroidery; silk; mid Warring States Period (475-221 B.C.); Changsha, Hunan Province, China.<sup>3</sup>



Figure 2.4 Cloud embroidery from Mawangdui Tomb; silk; Han Dynasty (175 B.C.); Changsha, Hunan Province, China.<sup>4</sup>



When Buddhism was influential during the Wei and Jin dynasties (A.D. 220-420), many embroidery artifacts were found to depict images of Buddha achieved with combinations of various stitches (Geng, 2010). During the Tang dynasty (A.D. 618-907), one of the most prosperous time in Chinese history with flourished arts, embroidery was

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<sup>3</sup>From website <http://www.suxiuwang.cn>

<sup>4</sup>From website <http://www.suxiuwang.cn>

applied on daily life products and appeared increasingly detailed and even in stitching (Geng, 2010). Artisans started to develop a way to skillfully fuse elements of painting into embroidery, in which the embroidery visually appears as if painted with needles (Figure 2.5). By the Song and Yuan dynasties (A.D. 960-1368), new materials and improved tools were utilized to allow versatility in embroidery creation. For example, hair embroidery and fine metal needles were created during the Song dynasty. With heavy Mongolian and Jurchen cultural influences, artists from this time period also began to adopt the metal thread embroidery. In particular, Chinese painting and calligraphy were introduced to embroidery as sources of inspiration and subject during the Song dynasty (Figure 2.6).

Figure 2.5 Saddle blanket with jewel-toned embroidery on golden background, depicts embroidery in painting-like application; silk; Tang dynasty (A.D. 618-907); Turfan, Qinghai Province, China.<sup>5</sup>



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<sup>5</sup>From website <http://www.suxiuwang.cn>

Figure 2.6 Double birds and begonia embroidery in Chinese painting style; silk; Song Dynasty (A.D. 960-1279); Shengyang, Liaoning Province, China.<sup>6</sup>



By the Ming and Qing dynasties (A.D. 1644-1911), embroidery had reached a high level of artistry (Figures 2.7-2.8). Aside from the imperial embroidery, this art form had blossomed into a variety of regionally formed styles (Geng, 2010). The four major styles of Chinese embroidery, still recognized today, are Su Xiu from Jiangsu Province, Shu Xiu from Sichuan Province, Xiang Xiu from Hunan Province, and Yue Xiu from Guangdong Province. At the same time, embroidery styles emerged locally in some major cities, such as Jing Xiu from Beijing and Gu Xiu from Shanghai. Among the 56 Chinese ethnicities, groups such as Miao, Uyghur, Tibetan, and Mongolian, had also developed their own unique styles of embroidery with culturally specific patterns and symbols.

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<sup>6</sup> From website <http://www.suxiuwang.cn>



Figure 2.7 One hundred children embroidered on woman's bodysuit; silk; Ming dynasty (A.D. 1368-1644); Beijing, China.<sup>7</sup>



Figure 2.8 Three Gods embroidered scroll; silk; Qing dynasty (A.D. 1644-1911); Beijing, China.<sup>8</sup>



Out of the various embroidery styles, Su Xiu of Jiangsu Province has become known as the leading Chinese embroidery style that represents the finest stitching and the

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<sup>7</sup>From website <http://www.suxiuwang.cn>

<sup>8</sup>From website: <http://www.suxiuwang.cn>



highest techniques in China. In the recent few centuries, it has played an important role in influencing a number of embroidery styles in China. In this project, I focused on researching and exploring techniques of Su Xiu as well as its predecessor, Gu Xiu, and its own distinct branches of embroidery, including Shen Xiu and Luanzhen Xiu or Random stitch embroidery.

### ***Gu Xiu***

Gu Xiu embroidery style is important to discuss as I focus my research project around Su Xiu. As the predecessor of Su Xiu, Gu Xiu heavily directed the development of embroidery in southeastern China. By Ming dynasty (A.D. 1368-1644), the southern region of Yangzi River had become the center of silk textile and hand embroidery. Almost every household, at the time, raised silkworms (Lin, 2006). Embroidery in this dynasty comes from several major sources. Women from rich families practiced embroidery as a way of self-fulfillment and to satisfy the standard of female virtue. Like the Song and Yuan dynasties (A.D. 960-1368), the royal court also established an embroidery workshop as an official department (Lin, 2006). The famous Shanghai Gu Xiu was named after Gu Mingshi, a Ming dynasty court civil official who was very well educated in literature and art. It served as the predecessor of Su Xiu and the other major Chinese embroidery styles known today: Xiang Xiu, Yue Xiu, and Shu Xiu.

Under Gu Mingshi's educational influence, the women of his family developed interest and knowledge in art, calligraphy, and embroidery (Shen & Zhang, 2010). Thus, Gu Xiu reflected more spiritual and artistic value than practicality (Figure 2.9). Since then, it has been known for its unique selection of elegant subjects as well as literature inspiration that was culturally and historically significant. More importantly, it excelled in combining embroidery with Chinese painting while utilizing an assortment of inventive stitch techniques (Shen & Zhang, 2010). The most common stitch techniques included parallel, base, seed, single-variegated, and scale stitches (Figures 2.10-2.14). In this project, some of these stitches were explored. To allow a more vivid portrait of the subject matter, Gu Xiu also introduced the color mending and color value techniques through exploration of diverse values for each color group in conjunction with various stitch types (Shen & Zhang, 2010).

Figure 2.9 Women of the Famous Literature of Song and Yuan Dynasties (partial); embroidery by Han Ximeng; silk; Ming dynasty (A.D. 1368-1644); Shanghai, China.<sup>9</sup>



Figure 2.10 Three types of parallel stitch diagram (horizontal, vertical, and diagonal stitch).<sup>10</sup>

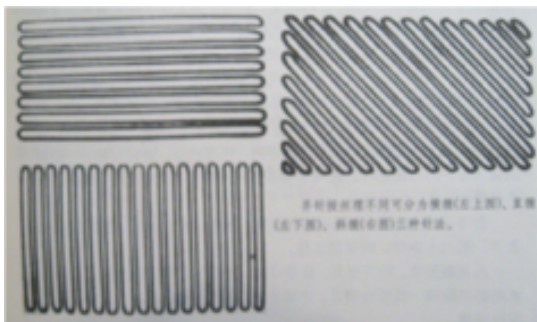


Figure 2.11 Base stitch diagram.<sup>11</sup>



<sup>9</sup>From website <http://www.suxiuwang.cn>

<sup>10</sup>From Shen, S., & Zhang, J. (2004). 雪宦绣谱图说. [Pictorial survey of Xueyi's embroidery handbook]. Y. Wang, (Ed.), p.55.

<sup>11</sup>From Shen, S., & Zhang, J. (2010). 雪宦绣谱：传统手工刺绣针法、绣要与剖析. [Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch techniques and guidelines]. J. Geng, (Ed.), p. 47.

Figure 2.12 Seed stitch diagram and stitched sample.<sup>12</sup>

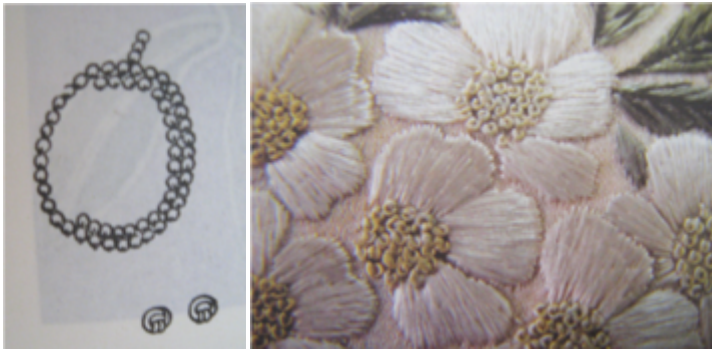


Figure 2.13 Single-variegated stitch diagram and stitched sample.<sup>13</sup>

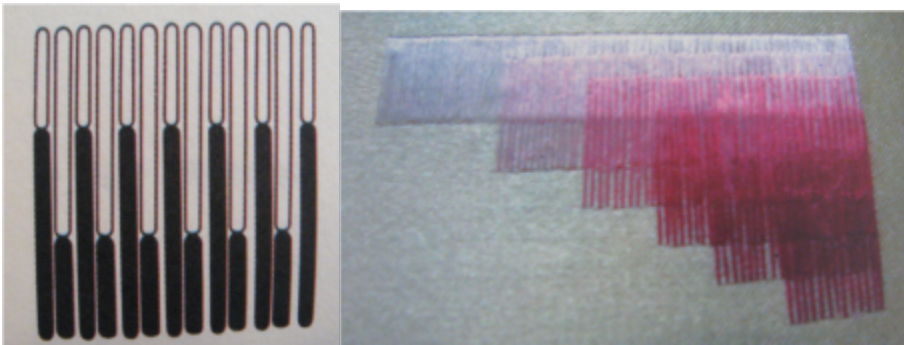


Figure 2.14 One type of scale stitch diagram and stitched sample.<sup>14</sup>



<sup>12</sup>From Shen, S., & Zhang, J. (2004). 雪宦绣谱图说. [Pictorial survey of yijun. Xueyi's embroidery handbook]. Y. Wang, (Ed.), pp. 79-80.

<sup>13</sup>From Shen, S., & Zhang, J. (2004). 雪宦绣谱图说. [Pictorial survey of yijun. Xueyi's embroidery handbook]. Y. Wang, (Ed.), p. 62.

<sup>14</sup>From Shen, S., & Zhang, J. (2010). 雪宦绣谱: 传统手工刺绣针法、绣要与剖析. [Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch techniques and guidelines]. J. Geng, (Ed.), p. 51.

Gu Mingshi's grand-daughter-in-law, Han Ximeng, created the exquisite use of colors and stitching techniques which reflected the peak performance of Gu Xiu (Shen & Zhang, 2010) (Figure 2.9). By the fall of Gu's family, Gu Mingshi's great grand-daughter, Gu Lanyu, had helped to spread the once secretive Gu Xiu techniques through teaching for apprenticeships and in factories for thirty years (Shen & Zhang, 2010). However, Gu Xiu requires not only a skilled craftsman but also a well-educated artist; thus, further development was challenging at the time and resulted in its decline in popularity. Meanwhile, Su Xiu, as another style of embroidery art, slowly emerged in the nearby city, Suzhou.

### *Su Xiu*

After development in Gu Xiu during Ming dynasty (A.D. 1368-1644), Su Xiu gained its importance during Qing dynasty (A.D. 1644-1911) and became well known for its fine stitching amongst the vast embroidery styles. Centralized in the city of Suzhou, today's Su Xiu also is famous for its lifelike imagery, various material usages, and its creative advancement in techniques that fuse eastern and western art elements. Traditionally, Su Xiu was created by applying silk floss on a silk fabric background that may vary in weave structure, such as gauze or satin. Later, especially after the Yuan dynasty (A.D. 1271-1368), substantial improvement was evident as metallic threads were incorporated, such as gold floss, silver floss, and gold- or silver-wrapped floss (Lin, 2006). Today, Su Xiu allows around 40 types of stitch techniques along with a set of stitch standards (Zhu, 1987). Feng Zhu (1987), a renowned Su Xiu master, summarized the eight different characteristics of Su Xiu:

- Smoothness: flat and even embroidery surface
- Shine: clear and colorful appearance
- Neatness: even stitch ends and outline
- Balance: well-balanced thickness of stitches
- Harmony: well-planned color palette and value
- Transition: smoothly transitioned curves and corners and color value
- Fineness: detailed stitching

- Compactness: tightly packed stitching

Traditional imagery of Su Xiu includes subjects such as flowers, birds, cats, goldfish, landscapes, and maids (Figure 2.15). In addition to the traditional imagery, present day Su Xiu also includes the embroidery of human portraits that utilize the innovative techniques of painting and stitching. In recent decades, Su Xiu also found new creative possibilities, such as bifacial embroidery and contrasting bifacial embroidery (Figure 2.16). For this project, I concentrated on exploring the application of the most common Su Xiu stitch techniques, including a few of its related embroidery techniques that were vital to the growth of Su Xiu.

Figure 2.15 Fluttering; painting by Zhou Tianmin, embroidery by Shan Xiaoping; silk; 1985; Suzhou, Jiangsu Province, China.<sup>15</sup>



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<sup>15</sup>From Dowdey, P. (1999). *Threads of Light: Chinese Embroidery from Suzhou and the Photography of Robert Glenn Ketchum*. p. 108.

Figure 2.16 Front (left) and back (right) of bifacial embroidery.<sup>16</sup>



### ***Shen Xiu***

Shen Xiu, based in Nantong, Jiangsu Province, is a branch of Su Xiu that represents the highest level of Su Xiu techniques. Its existence further advanced and elevated Su Xiu in the embroidery world. The realistic imagery of modern day Su Xiu was developed from Shen Xiu's technique and concepts, known as Fang Zhen Xiu or Lifelike Embroidery. If Su Xiu is a craft, then Shen Xiu is art (Hu, 1999). Shen Xiu was named after Shen Shou, originally named Shen Yunzhi, who was born in 1874 in Wu County of Jiangsu Province during the late Qing dynasty (A.D. 1644-1911). Shen Shou was monumental in advancement of Su Xiu in the modern history. In late Qing dynasty (A.D. 1644-1911), Shen Shou's work of *Eight Saints in Celebration* was presented as the seventieth birthday present to the Empress Dowager Cixi who instantly gave high appraisal and bestowed her the character Shou, meaning longevity. Soon after, the Qing court sent Shen Shou and her husband, Yu Jue, to Japan for art education research. There, Shen Shou studied sketch, oil painting, and photography, from which she understood the techniques and principles applied in Western art (Hu, 1999). The lighting element, used in oil painting and photography, created vivid, three-dimensional affects that inspired her to generate a new style of embroidery, the "Imitation of Reality Embroidery" or "Lifelike Embroidery" (LaFleur, 2001).

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<sup>16</sup> From [Photograph by Lushan Sun]. (2010)



This branch of embroidery technique is based on Su Xiu's existing stitches. The flat stitches, consisting of the straight stitch of various lengths loosely and evenly applied layer over layer, are traditionally used in illustrating animal feathers or fur, and it appears neat but fixed. Shen Shou used the flat stitch on top of the variegated stitch to achieve vivid and three-dimensional effects (Figure 2.17). She also utilized the spiral stitch and semi-realistic stitch to mimic the pattern and direction of hair, fur, and muscle (Figure 2.18-2.20). Another change that Lifelike Embroidery brought was the versatility of embroidery subjects and sources of inspiration. Consequently, Shen Xiu was able to introduce a few other types of original sources for embroidery from her study, such as Western paintings and photographs. Many experts appraise Shen Xiu's technique in handling light with innovative stitches and thread color choices that capture the essence from the subject matter into this art form (Hu, 1999). Naturally, Shen Shou was instrumental in bringing vivid life-like imagery to Su Xiu.

Figure 2.17 Raised stitch diagram.<sup>17</sup>



Figure 2.18 Spiral stitch diagram.<sup>18</sup>



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<sup>17</sup>From Shen, S., & Zhang, J. (2010). *雪宦绣谱：传统手工刺绣针法、绣要与剖析*. [Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch techniques and guidelines]. J., Geng, (Ed.), p. 53.

<sup>18</sup>From Shen, S., & Zhang, J. (2010). *雪宦绣谱：传统手工刺绣针法、绣要与剖析*. [Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch Techniques and Guidelines]. J., Geng (Ed), p. 65.

Figure 2.19 Semi-realistic stitch diagram and stitch example.<sup>19</sup>

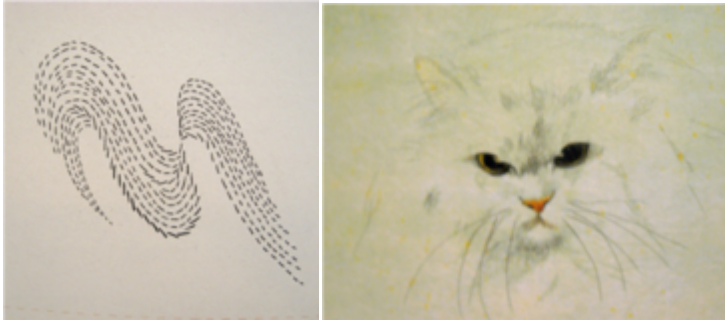


Figure 2.20 Portrait of Christ; embroidery by Shen Shou, designed by Yan Wenliang; silk; Qing dynasty (1911).<sup>20</sup>



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<sup>19</sup>From Shen, S., & Zhang, J. (2010). 雪宦绣谱：传统手工刺绣针法、绣要与剖析. [*Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch Techniques and Guidelines*]. J., Geng (Ed), p. 68.

<sup>20</sup>From Pu, Y. (2002). 中国沈绣. [*Chinese Shen Xiu*]. p. 23.



### ***Luan Zhen Xiu (Random Stitch Embroidery)***

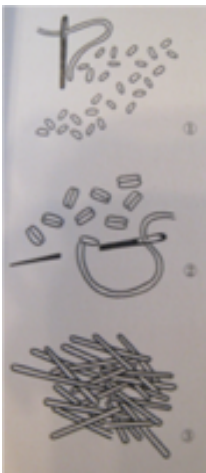
In the early 1930s, a woman named Yang Shouyu, from Danyang, Jiangsu Province, gained recognition in the world of Su Xiu for creating Luan Zhen Xiu, also known as Random Stitch Embroidery. She was both born and married into a wealthy family that gave her the financial security to pursue the artistry of embroidery (LaFleur, 2001). Growing up in a scholarly family, Yang Shouyu was trained in Chinese painting and had the opportunity to learn impressionistic oil painting from her cousin, Liu Haili, who had studied art in Paris (Zhang, 2004). Yang Shouyu was inspired by the idea of applying short and fragmented brush strokes of pure colors against complimentary colors that allowed the main colors to appear closer to the eye. Having the fundamental knowledge in both Chinese and Western painting, she was able to revolutionize the typically arranged, neat and compact stitches of traditional Chinese embroidery. Yang Shouyu experimented with crisscross stitching of uneven length in non-conventional patterns (Zhang, 2004). Luan Zhen Xiu, based in Changzhou of Jiangsu Province, was born (Figure 2.21).

Random Stitch Embroidery is not as random as it sounds. The stitches follow a strategically arranged pattern depending on the subject and specific area of the overall design. By applying stitches in compact and loose, and long and short manner, one can develop perspective, lightness, and darkness that are essential to Western painting. Like, Shen Xiu, Random Stitch Embroidery is also time consuming in that it is built upon layers and layers of stitches (Figure 2.22). Usually, three layers of stitches are applied in different shades of a color (Figure 2.23). The first layer requires a base or background color that would support the contrasting colors on the second and third layers (Shen & Zhang, 2010). The outcome appears life-like and in motion. Like Shen Shou, Yang Shouyu emphasized realism in her embroidery (LaFleur, 2001). The random stitch used to create depth and value has further guided Su Xiu in its advancement from which people portraits has become a common subject in modern day Su Xiu.

Figure 2.21 Young Girl; Luan Zhen Xiu (Random Stitch Embroidery), embroidery by Yang Shouyu.<sup>21</sup>



Figure 2.22 Three layers of the random stitch diagrams.<sup>22</sup>



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<sup>21</sup>From Dowdey, P. (1999). *Threads of light: Chinese embroidery from Suzhou and the photography of Robert Glenn Ketchum*.p. 25.

<sup>22</sup>From Shen, S., & Zhang, J. (2010). 雪窟绣谱：传统手工刺绣针法、绣要与剖析.[*Xueyi's embroidery handbook: Analysis of traditional hand embroidery stitch techniques and guidelines*]. J.,Geng (Ed.), p. 77.

Figure 2.23 Detail of Snowfall; Luan Zhen Xiu (random stitch embroidery) by Ji Shaoping; gelatin silver print by Robert Glenn Ketchum; silk on organza; 1986.<sup>23</sup>



### ***Traditional Materials***

Traditionally, silk floss and silk fabric were dyed with natural dye separately as supplies for Su Xiu. In this project, various Su Xiu techniques were explored with combinations of hand embroidery floss in silk, wool, and cotton fibers, and dyed together after stitching on various naturally fibered fabrics. Each of these natural fibers is known to react differently to different dye color (e.g., wool often dyes darker than silk and cotton). Thus, the utilization of these fibers provided a wide range of color value for the embroidery flosses and fabrics in this project.

### ***Social Influence of Su Xiu***

In the most primitive period in China, embroidery was first applied on garments, then, on household furnishing. Soon after, it had obtained both functional and aesthetic aspects in design. Later progress transformed Chinese embroidery into a form of art through the fusing elements of Chinese painting into embroidery, known as Su Xiu. Today, Su Xiu is able to include Western painting elements in its technique and overall

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<sup>23</sup>From Dowdey, P. (1999). *Threads of light: Chinese embroidery from Suzhou and the photography of Robert Glenn Ketchum*. p. 32.

effect. Su Xiu also means embroidery of the Jiangsu Province where the city of Suzhou is known as the “heaven on earth” or the “Venice of East”. Situated by the lower bank of the Yangzi River in Jiangsu Province, the city of Suzhou provided the ideal natural setting for this art. The vast cultivation of silkworm, natural landscape, moderate climate, stable economic growth, and deeply rooted culture all contributed to the development of Su Xiu (Lin, 2006).

Archeological discovery indicates Su Xiu had come into existence during the Spring and Autumn Period (770-390 B.C.), a multidimensional and perplexed period during which this craft reached maturity where function and aesthetic co-existed in the embroidery produced (Sun & Ma, 2006). Around 1000 years later, in Nanjing, the capital of Jiangsu Province today, the first known embroidered map was created for the Wu Kingdom’s territory during the Three Kingdom Period (A.D. 220-280) (Lin, 2006). This evidence indicates that Su Xiu had spread to wider areas around the Yangzi River by this time. The earliest known Su Xiu artifact, a book wrap cloth (Figure 2.24), was discovered in a Buddhist pagoda of the Song dynasty (A.D. 960-1279) in Suzhou (Lin, 2006). This valuable artifact depicts a portion of lotus flower, a Buddhist symbol, in the center with begonia rays out in four directions on a burgundy silk background. Not only does this piece reflect Su Xiu’s use of color combination but also represent the early application of various Su Xiu stitches, such as loose stitch, variegated stitch, and braid stitch (Lin, 2006).

Figure 2.24 Embroidery remain from a Buddhist scripture cover; silk; Northern Song dynasty (960-1127 C.E.); Suzhou, Jiangsu, China.<sup>24</sup>



<sup>24</sup>From Dowdey, P. (1999). *Threads of light: Chinese embroidery from Suzhou and the photography of Robert Glenn Ketchum*. p. 23.

Moreover, the Qing dynasty (A.D. 1644-1911) court had set its silk and embroidery factory center in Suzhou, Nanjing, and Hangzhou, well known as the Three Jiangnan Silk Factories. Having the financial stability, Suzhou had become a better-suited place for cultivation of Su Xiu (Lin, 2006). Famous literati and educated rich noble men as well as government officials who lived in and traveled to Suzhou also attribute to Su Xiu's rich development. As people of Suzhou became more educated and developed mature appreciation for the arts, Su Xiu evolved in its choice of subject and style in response to its consumer's demand that also in turn directed the advancement of the art (Lin, 2006).

Su Xiu, in the past few centuries, has also promoted economy and education in the Jiangsu Province. At the fall of the Qing dynasty (1911), while imperial embroidery workshops ended, Shen Shou was invited to Nantong, Jiangsu Province, to serve as the director of the first Chinese Women's Embroidery Technical School in request of Zhang Jian, a famous educator, industrialist, and Qing court's official (Chen, 2002). With the passion for education, together they allowed women of various social statuses to become educated and skilled in the craft. Soon, more embroidery schools opened in major cities of Jiangsu Province (LaFleur, 2001). In 1914, Shen Shou was appointed as the head of the Nantong Textile Department that later branched out with international offices in the U.S., France, Belgium, and Italy. Such expansion gained Shen Shou and Su Xiu international influence and status that later served as a foundation for much potential business.

Moreover, Su Xiu's contribution lies in maintaining and promoting healthy international relations and alliances while promoting Chinese cultural heritage. In 1910, Shen Shou had developed her first Lifelike Embroidery art piece, *The Italian Queen*, which was given to Italy as a national present from the Qing court. The same piece won extensive praise from the Italian court and also won first place at the Turin International Fair in 1911 (Dowdey, 1999). In 1915, Shen Shou's *Portrait of Christ*, received the gold medal at Panama-Pacific International Fair in San Francisco where Su Xiu truly gained worldly recognition (Dowdey, 1999). In recent decades, Shen Xiu, was practiced by Shen Shou's students who continue to help building international relations for China. In 2009, Shen Xiu, now listed in Chinese Intangible Heritages, created *President Obama's Merry*

*Family*, which was given to President Obama as a national present from the government of People's Republic of China in 2009 (Figure 2.25).

Figure 2.25 *President Obama's Merry Family*; embroidery by Yin Junping, Zhou Jin; design by Bo Yuan; silk; 2009; Nantong, Jiangsu Province, China.<sup>25</sup>



Before Shen Shou died at the age of 47 in 1921, Zhang Jian recorded her oral dictation of the *Xue Yi Embroidery Handbook* (Lin, 2006). As the first book that explains embroidery techniques in an organized manner, *Xue Yi Embroidery Handbook* also provides the guidelines for discipline and morals that an embroidery artist should practice (Lin, 2006). It explains how an embroidery artist should act and think as well as important tips, such as one should not wet the thread tip when threading a needle (Lin, 2006). Most importantly, this book enables the inheritance of Su Xiu for future generations. Shen Shou educated many of the outstanding scholarly embroidery artists who played important roles after the People's Republic of China was established in 1949. Among her students, Jin Jingfen became a renowned embroidery master and the first director of the Suzhou Embroidery Research Institute (SERI) that educated generations of exceptional embroidery artists (Dowdey, 1999).

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<sup>25</sup>From website <http://elite.youth.cn/>

Today, decades later, many local Su Xiu enterprises in Jiangsu have increased in scale and are steadily growing. Some of the embroidery artists are entrepreneurs from rural areas, and most have obtained their knowledge and skills from professional technical schools of embroidery in Suzhou and nearby cities, such as Nantong. Thus, they are able to develop a profitable career for themselves to support their family. This, in turn, not only decreases the rate of unemployment but also helps to stabilize the society as a whole. However, it should be recognized that Su Xiu is a time consuming craft when applied in fine stitching. Modern day Su Xiu incorporated the Western painting ideology that opened doors for Chinese embroidery into the west. International apparel designers are often inspired by the exquisite visual appearance of Su Xiu. Regardless, most Su Xiu seen in the Chinese market is still produced as art décor in the form of wall hangings, or home furnishings. Even though modern day technology has allowed Su Xiu to branch out into machine embroidery for apparel and household items, garment production with exquisite and innovative hand embroidered Su Xiu is still limited. More importantly, machine embroidered garments and items lack the appeal of creativity in stitching, three-dimensional appearance, and the natural stitching transition of hand embroidery.

### ***Chinese Resist and Dyeing Techniques***

About two thousand years ago, China had already obtained methods for standardized color dyeing, each color hue was named and organized in groups, and sophisticated technologies in the bleaching and surface design industries were established (Huang, 1998). After thousands of years of development, four principal resist dyeing techniques have been passed down in Chinese history from various regions of dynamic subcultures: Hui Xie (paste resist), La Xie (wax resist), Jiao Xie (tie-dye resist), and Jia Xie (folding and clamping resist) (Zhang, 2006).

Hui Xie technique, or paste resist dyeing, usually produces what is now known as Blue Calico. It is a chemically resisted and stenciled fabric in which lime powder-based paste is applied through the stencil as a chemical resist before the fabric is immersed in a woad dye bath. It is mainly produced in Shejiang, Hunan, Shanxxi, and Jiangsu Province (Wu, 2006). Today, the most influential Blue Calico is from Nantong, Jiangsu. The earliest discovery of Blue Calico was in the Northern dynasty (420-588 C.E.) (Wu,

2006). Later, during the Tang dynasty (620-950 C.E.), other types of Blue Calico were introduced (Wu, 2006). After the Yuan and Ming dynasties (A.D. 1279-1644), cotton production dramatically increased around the southern Yangzi River region that led to the development of Nantong Blue Calico (Wu, 2006).

The other historically practiced dyeing technique in China was La Xie, meaning wax resist dyeing or batik. It is also a traditional technique practiced in most of Eastern Asia (Huang, 1998). In China, batik was most famous in the Guizhou Province, known as Home of Batik, where many minority groups live, such as Miao, Dong, and Buyi ethnicities (Balfour-Paul, 1996). Batik is a process where melted wax is applied to fabric using various tools in order to protect the waxed area from dye colors. During the Northern Dynasty (A.D. 420-589), most batik fabrics are seen with white flowers on a blue background (Huang, 1998). By the Tang and Song dynasties (A.D. 618-1279), many vibrant colors started to appear in batik textiles (Huang, 1998). The images and symbols illustrated in Guizhou batik are mostly from nature, such as small animals and plants (Huang, 1998).

Among the four major resist dyeing techniques, Jiao Xie (tie-dye) and Jia Xie (folding and clamping) will be explored and reinvented for the purpose of this project.

### ***Jiao Xie (Tie-dye)***

Jiao Xie, or commonly known as *zha ran* in Chinese and *shibori* in Japanese, simply means tie-dye, which is one of the principal ancient resist dyeing techniques in China. Yunnan, Guizhou, and Jiangsu Provinces are the main regions that produce such craft. Jiao Xie is a way to achieve pattern on fabric through physical resist techniques, such as stitching. The stitched or bound areas resist the dye and upon release of the stitching or binding, pattern is created. Resisted fabric can be immersed in a dye bath or manually dyed by hand in desired areas. Archeological findings provide evidence that Jiao Xie's first appearance was around the 3<sup>rd</sup> century (Huang, 1998). By the 6<sup>th</sup> century, this method spread to many Asian countries, such as Japan, where it has been kept alive (Jiao, 2009). Murals of the Tang dynasty (618-907 B.C.) from Xinjiang Uyghur Autonomous Region indicate the wide practice of such techniques (Huang, 1998). Unlike the Tang dynasty (618-907 B.C.) when Jiao Xie prospered, the Song dynasty (960-1279 B.C.) court found it to be time consuming and expensive in raw material cost and



attempted to ban such practice (Jiao, 2009). Some local workshops still continued to practice Jiao Xie and allowed it to survive under such circumstances, especially when cotton replaced the costly silk as the raw material (Wu, 2006). After the Qing dynasty (1644-1911) and the Republic of China (1911-1949), Jiao Xie has been through constant war and social revolution that has dramatically slowed down its development (Jiao, 2009). Nantong in Jiangsu Province is one of the few locations in China still persistently sustaining such craft (Jiao, 2009). During the 1970s, China initiated its political reform and rebuilt foreign relations with Japan who saw the vast similarities in Jiao Xie and shibori (Jiao, 2009). Japan started to see China as the cheaper offshore sourcing location for shibori, and Nantong took the business opportunity and started reviving the Jiao Xie industry in China (Jiao, 2009).

Currently, there are two main categories of Jiao Xie techniques in China: Zha Jiao, or binding, and Feng Jiao, or stitching (Jiao, 2009). Zha Jiao, or binding, is done using a thread to wrap a small area four times forming dot-like patterns (Jiao, 2009). Fabric dyed and resisted with Zha Jiao is historically known as Fish Roe Fabric for the rice size patterns (Jiao, 2009) (Figure 2.26). Feng Jiao, or stitching, is created using thread to outline the desired pattern; the thread is drawn tightly to secure the resist (Jiao, 2009) (Figure 2.27). In the past few decades, Nantong industrialized Jiao Xie craft and thus developed numerous innovative stitching techniques based on the traditional method (Jiao, 2009).

From existing traditional Chinese Jiao Xie techniques, pole-wrapping resist was later developed by Japanese dyers who called it *arashi shibori* in Japanese, meaning irregular pattern (Figure 2.28) (Wada, 1983). Linear striation is created through the process of wrapping cloth around a pole and compressing it into folds (Wada, 1983). According to Wada, a well-known shibori fiber artist and scholar, many physical resist dyeing techniques in Japan have Chinese provenance due to the active interchange between the two cultures dating back to the 6<sup>th</sup> century with peak interchange during the Tang dynasty (618-907 B.C.) (Wada, 1993). In modern history, the pole-wrapping dyeing technique was adapted in Japan and America by artists (1993).

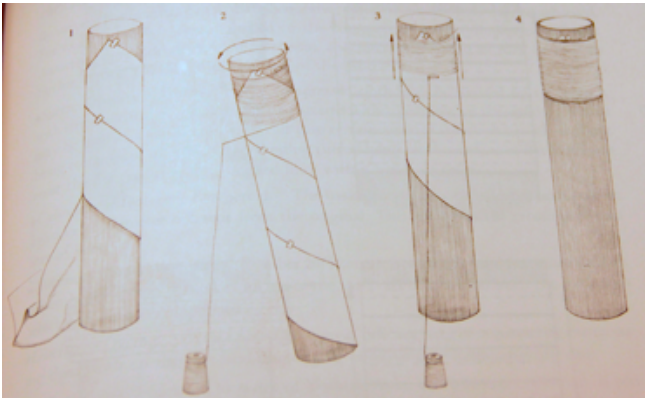
Figure 2.26 Fabric bound with zha jiao (binding) technique.<sup>26</sup>



Figure 2.27 Fabric stitched with feng jiao (stitching) technique.<sup>27</sup>



Figure 2.28 Four steps of pole-wrapping technique: secure fabric around cylinder, wound thread around fabric, secure thread to fabric, and compress fabric.<sup>28</sup>



Like embroidery images, the symbolic patterns created on resisted and dyed textiles are usually interpreted or taken from everyday life or nature, such as various forms of butterfly, bats, and flower (Figure 2.29). The most common traditional dye source for Jiao Xie is indigoid dye plant. Jiao Xie techniques allow for over-dyeing to

<sup>26</sup>From website <http://amuseum.cdstm.cn/AMuseum/silk/rx0501.html>

<sup>27</sup>From website <http://amuseum.cdstm.cn/AMuseum/silk/rx0501.html>

<sup>28</sup>From website Wada, Y., Rice, M., & Barton, J. (1999). *Shibori: The inventive art of Japanese shaped resist dyeing*. p. 125.

create multi-colored patterns (Huang, 1998). Today, Jiao Xie survives by applying mainly synthetic dye that is accepted by mass-market apparel producers and consumers.

Figure 2.29 Dali Zha Ran in cotton; Dali, Yunan Province, China; 2010.<sup>29</sup>



In this project, variations of binding, stitching, and pole-wrapping were explored. In addition, Jia Xie or folding and clamping was explored as another physical resist dyeing technique.

### ***Jia Xie (Folding and Clamping)***

Jia Xie is another category of Chinese resist dyeing technique, commonly known as folding and clamping technique. It achieves pattern through folded cotton fabric that is placed between multiple identical carved wooden blocks. The stack is then secured with iron hoops and wooden blocks before immersing in a prepared woad bath. The resisted areas remain white while the areas exposed dye the classic dark blue (Zhang, 2006) (Figure 2.30-2.31).

Based on historical documentation, the invention of the Jia Xie technique can be traced back between Qin and Han dynasties (256-206 B.C.) (Zhang, 2006). However, the earliest discovery was found on the multi-colored robe of Budhisattva in Mogao Grottos, Dunhuang painted during the Tang dynasty (618-907 B.C.) (Zhang, 2006). In the Tang

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<sup>29</sup> From [Photograph by Lushan Sun]. (2010)

dynasty, the Jia Xie technique was applied with two identical carved wooden blocks sandwiching silk fabrics in between to achieve multiple colors through complex dyeing procedures. By the Song dynasty (960-1279 B.C.), Jia Xie fabric had almost replaced the embroidered and brocade fabrics and was limited to the royal court use (Zhang, 2006). Until the vast introduction of cotton fabric in Yuan dynasty (A.D. 1271-1368), Jia Xie technique faced a new challenge. With the same procedures applied, it was costly and difficult to produce multiple colors on cotton fabric; thus, Jia Xie technique was adapted for woad dye, which obtains the best result in color fastness (Zhang, 2006). In the Ming dynasty (A.D. 1368-1644), Jia Xie slowly lost its popularity due to the time-consuming block carving procedure. By the end of last century, such dyeing techniques only existed in a few barely surviving family dyeing workshops of southern Zhejiang Province (2006).

In Zhejiang Province, most Jia Xie patterns depict opera scenes with occasional flower, bird, and animal patterns. According to Zhang (2006), a Jia Xie expert and scholar, Jia Xie fabric is only used to make quilt covers depicting sixteen or twelve identical rectangular patterns (Figure 2.31). Traditionally, undyed cotton fabric 50 cm wide and 10 m long is folded and sandwiched between seventeen identical carved wooden boards to create sixteen identical rectangle shaped patterns (Zhang, 2006) (Figure 2.30). In this project, the Jia Xie technique was applied on both cotton and silk fabrics with contemporary accordion pleating procedures. The Jia Xie use of multiple carved blocks was simplified to the use of two square wooden blocks secured with a C-clamp.

Figure 2.30 Jia Xie quilt cover and detail; cotton; Zhejiang Province, China; 2010.<sup>30</sup>



<sup>30</sup> From website [http://www.yqswwh.cn/E\\_ReadNews.asp?NewsId=590](http://www.yqswwh.cn/E_ReadNews.asp?NewsId=590)

Figure 2.31 Cotton fabric applied with Jia Xie technique: folding and clamping fabric (left), securing resist (middle), unfold fabric after woad dyeing (right); Zhejiang Province, China; 2010.<sup>31</sup>



## Maintaining Eco-efficiency

### *Chinese Natural Dye*

Since William Perkin's discovery of synthetic dye in the 1850s, people have found that dyeing with synthetic dyes is a faster, simpler, and cheaper method of dyeing compared to the traditional natural dyes (Flint, 2008). Industrialization and globalization have driven the majority of our society to prefer the synthetic dye, which also contributed to the damage of the ecosystem. It was not until the 1920s and 1930s that China slowly replaced its once exclusive use of natural dye with synthetic dyes (Liu, 2010). At the time, synthetic dye was an important factor that made products fashionable and popular (Liu, 2010). In the environmentally conscious society today, the apparel and textile industry is shifting its attention back to natural dye.

The application of natural dye in China can be traced back to the Stone Age (Huang, 1998). The word dye in Chinese, *ran* (染), is written with three parts: water, number nine, and wood. The water part indicates the need for water in the dyeing

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<sup>31</sup> From website [http://yichan.folkw.com/www/feiyipic/141922751\\_3.html](http://yichan.folkw.com/www/feiyipic/141922751_3.html)  
<http://www.pinbu.cc/1296.html>  
[http://www.yqswlh.cn/E\\_ReadNews.asp?NewsId=590](http://www.yqswlh.cn/E_ReadNews.asp?NewsId=590)

process, the number nine part indicates the many processing steps are involved in dyeing, and the wood part indicates that dyeing is produced using natural plants (Zhang & Chen, 2010). After China became unified in the Qin dynasty (221-207 B.C.), the royal court established workshops for various stages of textile dyeing. The dyeing procedures were standardized while colors were categorized to signify specific purpose or meaning, such as social status (Huang, 1998). By the Ming and Qing dynasties (A.D. 1368-1911), certain cities also had developed their own specialty in textile colors. The traditional dye sources included three categories of natural dye: mineral, plant, and insect. Here, only plant dye will be further explored due to its popular use and availability. The most common Chinese plant dyes are taken from the leaf, vein, root, skin, fruit or flower of indigo, woad, gromwell, madder, gardenia, safflower, mulberry, turmeric, pomegranate, and persimmon (Huang, 1998). For this project, I concentrated on three particular dye plants, woad, madder, and turmeric, which have been heavily used in the history of Chinese textile dyeing and are known for strong color fastness. These dye sources provide blue, red, and yellow hues, which reflect the three primary colors. I was able to utilize these hues in overdye techniques to create secondary colors with selected flosses and fabrics.

### ***Woad***

Woad (*Isatis indigotica*), or *song lan* and *ban lan gen* in Chinese, is also commonly known as Chinese woad (Cardon, 2007). It is cultivated mostly in eastern parts of China, such as Jiangsu Province, and is one of the major sources of the blue dye group, indigoid (Cardon, 2007). Historically, indigo dyed fabric has been instrumental in affecting aspects of the Chinese society, especially in economy (Liu, 2010). In the Ming dynasty (A.D. 1368-1644), blue dyed fabric could be supplied to the royal court to fulfill tax deficits. By the Qing dynasty (A.D. 1644-1911), large quantities of blue dyed fabrics were utilized for military uniforms, which caused dramatic expansion of the indigo dyeing industry. Traditionally, woad was used in dyeing silk, wool, linen, and cotton textiles (Yang, 2008). In the late 20<sup>th</sup> century, woad was mainly used to dye cotton, especially in the production of blue jeans (Yang, 2008). Today, the only application of woad dye in China is found among the traditional artisan groups who produce traditional crafts for a niche market like tourism.



Figure 2.32 Woad, *Isatis indigotica*.<sup>32</sup>



Woad is a bi-annual herb and usually grows in places with high humidity (Cardon, 2007). Its light yellow flower blossoms around summer time in China (Figure 2.32). Usually, the darker the leaf the more color it contains (Liu, 2010).

An essential procedure in preparing the woad dye mixture is its fermentation. This process is done to extract the indigotin from woad leaves and can be done naturally by fermentation or manually (Liu, 2010). In the Northern Dynasty (420-589 C.E.), fermentation was simply done by accumulating all woad leaves in a shallow hole in the ground and allowed time for thickening (Liu, 2010). Today, during September and October of Zhejiang Province, woad leaves are soaked for about seven days in a 1 meter deep round ground hole that holds about 113 kg of woad leaves (Liu, 2010). The ground hole needs to be stirred daily at night, before sunrise, as the daylight causes glare on water surface and may mislead the dye mixer to misjudge the fermentation completion (Liu, 2010). All water in this process is reused and guided through a separate channel in prevention of resource waste (Liu, 2010). Currently, most fermentation processes are based on experience and practice; however, under Western technology influence, Chinese chemists and dyers have been experimenting and advancing the fermentation process using a more efficient scientific approach (Liu, 2010).

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<sup>32</sup>From website <http://tool.zyy123.com/zybbg/qr/jddq.htm>

Woad is seen as a natural dye source by material, but it also represents a chemical reaction by the technique applied. Woad is a vat dye that needs no mordant, a substance that enhances the color outcome (Liu, 2010). Vat dye, one of the oldest known dye techniques, refers to the container that ferments indigo leaves (Brackmann, 2006). The hues produced are limited but intense. The blue color is the result of the oxidization process. Before woad is dissolved and exposed to air, it appears green-yellow in color (Liu, 2010). In China, woad is said to produce seven shades of blue, from the whitest blue to the blackest blue (Liu, 2010). Woad, like many other indigo species, is commonly used as an over-dye used in combination with base dye to achieve a variety of secondary colors. For example, woad over-dyed with madder can result in a gray-like color (Wipplinger, 2005). Further, Chinese woad-dyed textiles always attain a light pleasant smell before any finishing treatment applied (Zhang, Wu, Zhao, & Liu, 2010). Often, many Japanese importers prefer this special and mysterious quality in woad (Z. Wang, personal communication, January 3, 2011).

The colorfastness of woad has been tested and studied. Compared to synthetic dyes, it exhibits a disadvantage in colorfastness. However, as a natural dye, woad is known for its high rating in colorfastness, bright color range, and smooth hand (Zhang et al., 2010). Through modern day ultrasonic treatment to indigoid dyes, the performance of colorfastness and wear resistance are high, and the dyeing process is shortened due to the lower dye bath temperatures which increases the rate of coloration (Zhang et al., 2010). On the other hand, synthetically dyed fabrics may start to deteriorate after a year or even a few months due to the chemical content, whereas traditional Chinese woad dyed fabrics may last over ten years (Zhang, 2006).

### ***Madder***

Madder (*Rubia cordifolia L.*), or *xi cao* in Chinese, is known as one of mankind's most ancient red color dye source (Li & Suo, 2009). Archeologists have found garments dyed with madder from the Mawangdui Tomb of Han dynasty (175 C.E.) in Changsha, Hunan Province (茜草[Madder], n.d.). The color from this textile still retains its brilliance after several decades of exposure (Xiao & Liang, 2009). This not only indicates



the sophistication of dyeing technology in China at the time but also the high quality of madder's colorfastness.

*Rubia cordifolia L.* is known as Asian madder or Indian madder (Figure 2.33). It is a slender, branched, climbing plant, in which its long cylindrical root is used as the dye source (茜草[Madder], n.d.). According to the *Chinese Herbal Dictionary*, under the *Rubia* family, there are 60 kinds of madder species, in which 12 species grow in all areas of China, and the level of coloration within each also varies (茜草[Madder], n.d.).

Figure 2.33 Madder, *Rubia cordifolia L.*<sup>33</sup>



Madder is a natural dye that requires a premordant in its dyeing process to increase the coloration and colorfastness (Zhang & Cui, 2009). Madder, containing alizarin as its main color content, is only soluble in alcohol and alkaline liquids (Ke, Yu, & Xu, 2006). Research has shown that madder presents good quality of colorfastness and light resistance on cotton according to the American Association of Textile Chemists and Colorists rating system (Ke et al., 2006). Extensive study has improved madder's colorfastness and shortened dyeing time on cotton fiber by utilizing ultrasonic dye extraction methods compared to conventional liquid extraction methods (Liu & Cui, 2010). During this extraction, madder is processed under ultrasonic active water and cools before the filtration and drying procedures (Zhang & Cui, 2009). This method

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<sup>33</sup>From website <http://.a-hospital.com>

minimizes madder dye particles and consequently results in better saturation of color on fibers, such as cotton, wool, and silks (Zhang & Cui, 2009).

### ***Turmeric***

Turmeric (*Curcuma longa L.*), or *Jiang Huang* in Chinese, is a shrub related to ginger that is native to southern Asia and cultivated extensively in India (Gallant, n.d.) (Figure 2.34). It is most commonly known as a food seasoning in Indian curry. The Chinese traditionally use it as a powerful herbal medicine ingredient to cure various diseases according to the *Compendium of Medical Herbs* by Li Shizhen of Ming dynasty (A.D. 1368-1644) (Han & Mi, 2001). Turmeric is also known as the Treasure Burner Scent (姜黄[Turmeric], n.d.). In ancient times, a burner was used for creating room aroma and symbolized political power, and turmeric was granted with such name to describe its elegant fragrance and valuable purpose in medicine (姜黄[Turmeric], n.d.). Li Shizhen recorded 60 different species of the ginger family, and of which 16 species are grown in China (Han & Mi, 2001). Turmeric grows mostly in bushes and favors a warm climate. According to the *Herbal Illustration of Song Dynasty* (960-1279 C.E.), turmeric is commonly grown in the provinces of Jiangsu, Guangdong, and Sichuan (姜黄 [Turmeric], n.d.). It is simple in cultivation process, can be dug up during the winter, and sun-dried for storage (Sun, 2003). The vein and root are used for dyeing in which the root is thick and appears yellow (Sun, 2003). Today, the Sichuan province has the largest national turmeric cultivation base and has been funded by several prestigious national research grants (姜黄[Turmeric], n.d.).

Figure 2.34 Turmeric, *Curcuma longa* L.<sup>34</sup>



Turmeric is one of the natural dyes that produce a brilliant yellow color (Zhang & Cui, 2009). The main content is curcumin, a yellow crystal that is not water-soluble, and traditionally dyes on cotton, wool, and silk (Sun, 2003). However, it can be dissolved within an acid or alkaline liquid and high-temperature water (Ke, Yu, & Xu, 2006). It is best dyed directly and can be treated with premordant for bright or dark color variation (Ke et al., 2006). One study has shown that direct dye on silk produces a result with stable colorfastness and deep dye saturation (Zhang et al., 2010). However, disadvantage exists in turmeric dye's light resistance (Xu, 2006).

### ***Mordant***

In this project, I utilized mordant agents to improve the colorfastness and saturation. Mordant derives from the Latin word, *mordere*, meaning to bite (Bliss, 1993). For thousands of years, mordants have been used as the most efficient way of fixing natural color to fabric. The metallic content of mordants assist the fiber to receive coloration by absorbing the dye acids in plants (Bliss, 1993). In this study, various chemicals were applied to fabric during a pretreatment (i.e., premordant) stage for immersion dyeing with protein and cellulose fibers.

Many mordant chemicals are considered poisonous but can be nontoxic to the environment through limited usage (Redfern, 2001). Potassium aluminum sulfate (alum)

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<sup>34</sup>From website <http://6thsenselondon.com> [Photograph of Paul Mirocha].

is commonly used as a primary mordant and is considered nontoxic when used in proper proportions when natural dyeing for mordanting protein fibers (Duerr, 2010). Further, pickling alum, found in grocery stores, can be used as an alternative and is considered safe enough to eat (Redfern, 2001). The wastewater from pickling alum can be fed to plants that need acidity in soil (Redfern, 2001). The other important mordant is aluminum acetate. It is nontoxic and used for mordanting cellulose fibers (Wipplinger, 2005).

Moreover, some mordants serve as a color changer. Iron and citric acid were utilized in this project as pretreatment on floss and fabric to help create additional color value in fiber. Iron, ferrous sulfate, was used to create darker shade of color and is generally nontoxic in small doses (Duerr, 2010). Citric acid, found in vinegar and lemon, is an organic and odorless substance and commonly used as food additive (Setting powder, n.d.). It is used to lighten color in this project.

### **Environmental and Social Benefits of Chinese Embroidery, Resist Techniques, and Natural Dye**

Natural dye is derived from the natural environment, is not harmful to humans and contains qualities of biodegradability, regenerative ability, and zero-emission of environmentally polluting wastes. The benefits of natural dye are beyond the apparent function in textile dyeing production. The benefits of natural dye are being re-evaluated under the present day context as scientists discover more and more harmful chemically formulated dyes that cause allergies, cancer, and many other negative effects on humans and the environment. The medicinal benefits of some natural dyes are historically known and accepted in China. According to the *Compendium of Medical Herbs* from the Ming dynasty (1370-1645 C.E.), turmeric is used for relief of pain and swelling, and woad is widely used for the treatment of cold and flu (Liu, 2010). After woad leaves are harvested, its root is commonly sold for medicinal production (Liu, 2010). In addition, madder has long been used for treating vertigo, insomnia, rheumatism, tuberculosis, hematemesis, and menstrual disorders (Li, Liu, Chen, & Wang, 2009).

Among the vast species of natural dye plants, many are distinctive by their anti-bacterial, anti-inflammatory, and insect repellent traits (Zhang, Wu, Zhao, & Liu, 2010). Zang et al. (2010) analyzed pomegranate and gromwell root for their anti-UV quality and

found that textiles dyed with these plants had 80% UV absorption. In a recent study of madder root, results also demonstrated anti-microbial characteristics (Li et al., 2009).

Unlike synthetic dye, natural dye provides a range of organic and harmonious colors that fulfills one's desire of returning to nature in an eco-conscious society (Zhang et al., 2010). China has been practicing the craft of applying natural dye on textiles for thousands of years. Thus, China's historical applications of natural dye, current advancement of technology, and readily available dye plant resources are all able to contribute to a foundation for the revival of natural dye in China (Zhang et al., 2010). Some companies have already recognized the new potential for natural dyes and have initiated research and development using local natural dye sources. Beijing Bronze Ox Textile Limited Company introduced their naturally dyed textiles for children's wear (Zhang & Cui, 2009). Also, Jiangsu Jiangyin Third Textile Corporation has utilized natural dye to develop high-end textiles (Yang, 2008). Further, Shanghai Jeizhijin Dye Limited Company, China's largest dye production enterprise, has developed 50 natural dye colors for wool, silk, and cotton by combining traditional techniques with modern technology and equipment (Zhang & Cui, 2009). Like many other Asian countries that have initiated the reintroduction of natural dye, China funded the Hailan Corporation and Donghua University Textile Department with the leading National 863 High-tech Project to develop Natural Dye Equipment and explore Textile Development with Wool Production Cleaning Technology (Yang, 2008).

Looking at the development of the traditional dyeing industry in China, there have been many changes. After synthetic dye was introduced, the inefficient but culturally abundant dyeing crafts slowly lost its place in the market and the attention of both artisans and consumers. Many rural artisans find little business opportunity in their specialties and are relocating to urban cities in hope to earn a better living (Liu, 2010). However, under current eco-conscious pressure, Chinese society and government is refocusing its attention in preserving the crafts in fear of losing their arts and traditions. In the 1970s, Guizhou Batik was reintroduced in the Guizhou's Batik Factory through traditional and advanced technologies (Huang, 1998).

Likewise, the Jiao Xie craft has received attention in the Chinese apparel and textile industry. In the 1970s, Nantong, Jiangsu Province has developed a considerable

market to support Jiao Xie production (Jiao, 2009). However, challenges still existed. Gong Jianjun, the manager of Ranzhiyun Apparel Limited Company, started his business in Nantong where he produced and developed original apparel and home furnishing products for both clients in the 1980s and mainly exported his products to Japan and Korea while a small percentage went to Europe, America, and Southeastern Asia. (J. Gong, personal communication, January 1, 2011). As the market shrank in the last decade due to budget limitation for mass production and decreasing demand, he has sold his manufacturing location and now only custom produces for small orders and focuses on researching Jiao Xie technique in partnership with Nantong Textile Vocational Technology College (J. Gong, personal communication, January 1, 2011). Many similar companies still strive to find the niche markets that allow survival. Luckily, Nantong Jiao Xie tradition has been through some advancement in the past 30 years of research and development with a market covering more than 20 different countries, and many talents were educated to inherit and protect such art craft (Jiao, 2009).

On the contrary, Jia Xie is nearing extinction in China. Until the 1970s, Jia Xie quilt covers were still commonly used in gift giving for special occasions. The quilts usually lasted ten to twenty years of use (Zhang, 2006). However, after the adaptation of synthetic dye, the lifespan of Jia Xie fabric dramatically decreased to one to two years (Zhang, 2006). According to Zhang (2006), the real reason that Jia Xie technique phased out is its lowered quality and its complicated process. Manufacturers often produce it in a short amount of time in order to gain more profit while sacrificing occupational ethics; thus, the manufacturer's effort is vital in sustaining Jia Xie technique in China (Zhang, 2006).

As natural dye and traditional craft revive, our society is changing its attitude toward organic and cultural-oriented products through gaining valuable knowledge concerning this subject. Even though natural dye is increasing in its application, it is difficult to replace the use of synthetic dye in the apparel and textile industry. This is due in part to the limited research and lack of large-scale production. However, small quantities of production have a potential for profit from interested eco-conscious consumers (Zhang et al., 2010). At the same time, by researching and developing the

technologies of natural dye, diverse cultures can be further explored while tradition can possibly be sustained and advanced for the well-being of our environment and the society.

### **Justification**

The purpose of this design research was to support the slow design tenets of inheriting tradition and maintaining eco-efficiency by exploring traditional Chinese embroidery, dye-resist techniques, and natural dyeing in the creation of modern surface design on apparel. The hope was that the experience and outcome gained from this study would contribute to sustaining the spiritual and material civilization of Chinese culture. At present, some efforts have been made to develop the technologies in Chinese natural dyes in the creation of apparel as the world shifts gear toward environmental approaches in the apparel and textile industry. Chinese embroidery has also been reinvented or reinterpreted by both Eastern and Western designers. However, little efforts or attention has been put on the combination of such two unique elements carried out in apparel design, particularly applying Su Xiu, a decorative art, to a natural dyed substrate for a novel form of embroidery. Further, no study or artwork was found whereby color depth was created by varying the natural fiber content of the embroidery floss, which allows for differing depths of shade. For this project, color value was achieved by dyeing the embroidery and the fabric together as opposed to the traditional process of dyeing the embroidery floss and fabric separately.

The knowledge gained from this project through application of Su Xiu and resist dyeing techniques using natural dye, not only enhance two crafts in a creative manner but also provide an eco-efficient approach for this application on apparel. The slow design concept has been re-introduced in recent years to support the goal of inheriting cultural traditions as well as sustaining the environment. It incorporates design with intelligent and innovative choices of materials for minimal waste and negative environmental impact; and aesthetic, functional, and cultural value of the product. Through the combination of traditional textile arts applied to modern design, one can view such apparel as a piece of art with aesthetic value as well as an organic garment with practical and sentimental value. This project was designed to be relevant in both the arts and eco-conscious societies today under the slow design concept.

## **Chapter 3 - Methodology**

### **Practice-based Research**

This project utilized a practice-based approach to reflect the creative dynamic of the purpose, the design process, and the artistic outcomes. Gray and Malins (2004) define practice as “developing and making creative work as an explicit and intentional method for specific research purposes” (p. 104). Such an approach focuses mainly on qualitative research, and “it acknowledges complexity and real experience and practice - it is ‘real world research,’ and all ‘mistakes’ are revealed and acknowledged for the sake of methodological transparency” (Gray & Malins, 2004, p. 72).

Visualization is another important element in practice-based research for the artist and designer whereby the designer makes ideas visible through techniques, such as photography and sketching, to explore research project issues and findings (Gray & Malins, 2004). In such an approach, visual elements can further aid the interpretation, communication, and the amount of information conveyed to the public (Gray & Malins, 2004). Gray and Malins (2004) also indicate that the methods of practice can be effectively used in several processes of inquiry. For example, information can be collected through sketchbooks/notebooks, photography, 3D models/maquettes, and experimentation with material and process, and multimedia (Gray & Malins, 2004). Further, critical writing, publication, exposition, and peer feedback/review are also important in gaining reflective feedback on the research subject and visual outcome (Gray & Malins, 2004). Accordingly, this project utilized several of the methods to document and explain the practice-based research process: sketchbook/notebook, photography, 3D models, and experimentation with material and process.

### ***Naturalistic Inquiry***

One useful paradigm for practice-based research is naturalistic inquiry because it is essential to the “approach for real situations” (Gray & Malins, 2004, p.72). For example, in the interpretation of Lincoln and Guba (1985), naturalistic inquiry recognizes the importance of the natural setting, in this project namely the studio. Key characteristics of naturalistic inquiry are the intuitive or tacit knowledge that the researcher/designer



brings to the project, the fact that the researcher/designer is the primary generator of data, as well as the use of emergent and qualitative methods (Gray & Malins, 2004). During the development of creative design work, it is essential that the creator possess a combination of the basic principles of design and a solid understanding of the art and context of the proposed research. Moreover, the creator must realize, interpret, and explain the artistic value of the work, as well as have a form of review that allows the outcome to be interpreted (Gray & Malins, 2004). Accordingly, tacit knowledge brought to this project is based in culture and design experiences. First, my Chinese heritage provides an understanding of and experiences in Chinese traditions. Also important is the Western influence on my design aesthetic after my acculturation to U.S. since the age of 12. With a combined eastern and western cultural background, I was able to better reinterpret the traditional techniques in a modern context. Furthermore, the knowledge and experience I gained through previous study, such as years of training in art, apparel design, and textile dyeing, certainly benefited the project and served as a fundamental knowledge and experience base to draw upon. Additionally, I have studied and practiced Shen Xiu at the Shen Shou Art Museum in Nantong, China with local embroidery artists by learning the basic stitches and the process of traditional Su Xiu.

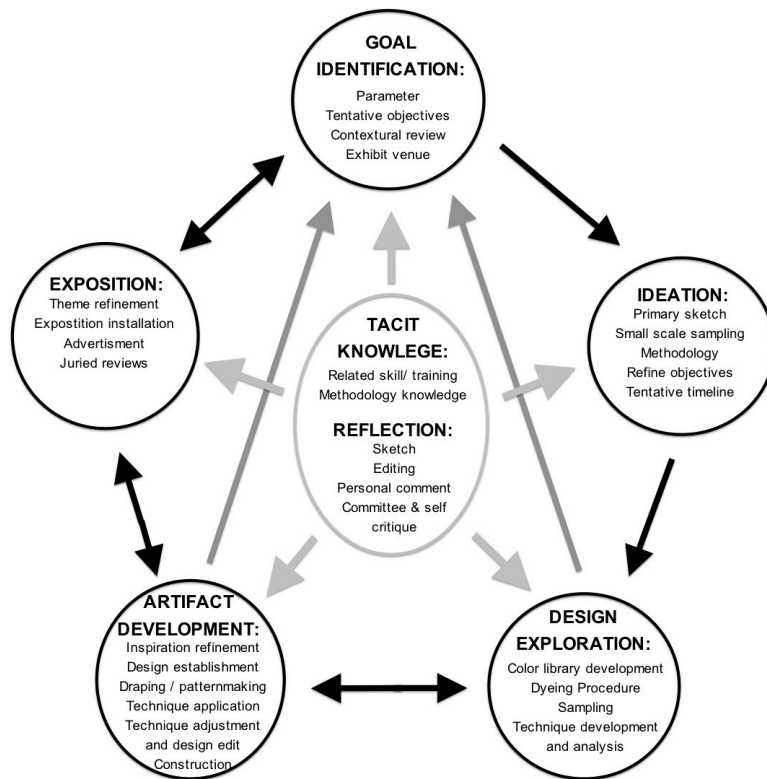
In this project, the design development and outcomes were considered under principals of slow design, which raises another important characteristic of naturalistic inquiry, the criterion of trustworthiness, for which evaluation criteria are generated to allow for critical review (Gray & Malins, 2004). In this case, my major professor and committee members served as a mean of feedback to allow necessary adjustment through the creation process and by evaluating the completed works. Meanwhile, outside review will be conducted through submission of the design(s) to an appropriate juried exhibition.

## **Methods**

The project was carried out through five research stages: goal identification, ideation, design exploration, artifact development, and exposition using tacit knowledge and reflection to gain understanding and develop appropriate analysis during the processes (Figure 3.31). In goal identification, Chinese Su Xiu and dyeing techniques were researched. Exhibit venue and tentative objectives were determined. During

ideation, the researched techniques were moderately explored to refine objectives and develop a timeline for the project. The design exploration stage consisted of development of a color library, dyeing procedures, and sampling traditional techniques and experimenting with new ideas, which provided a variety of results for analysis and technique development. The design exploration stage served as a foundation for the artifact development stage, in which designs were established with draping and patternmaking, technique application, design adjustment, and construction steps. The design exploration and artifact stages also included analysis of various outcomes against the given criteria for aesthetics and slow design. The last stage, exposition, involved refining the overall theme of the exhibit, exposition installation, creating advertisement, and submitting final outcomes for juried reviews; as well as presenting the designs and process for public review.

Figure 3.1 Research process flow diagram.<sup>35</sup>



<sup>35</sup>From [Figure by Lushan Sun] 2011.

The detailed plan of action was as follows.

## 1. Goal Identification

- a. Researched traditional Chinese techniques of the following:
  - i. Su Xui embroidery, focusing on the techniques of parallel, base, seed stitch, single-variegated, raised, spiral, and random stitch
  - ii. Jiao Xie resist techniques, focusing on the various Zha Jiao (binding) and Feng Jiao (stitching), Jia Xie (fold and clamping), and pole-wrapping techniques
  - iii. Natural dyes, focusing on woad, madder, and turmeric dye extract
- b. Researched modern apparel forms for inspiration by investigating the following:
  - i. Traditional Chinese design elements
  - ii. Chinese influenced modern fashion
  - iii. Appropriate apparel forms for light- to medium-weight fabrics chosen for this project
  - iv. Documented research via photography as further design inspiration
- c. Found exhibit venue

## 2. Ideation and Design Exploration

- a. Experimented with the following through sample making:
  - i. Su Xiu embroidery stitches in silk, wool, and cotton hand embroidery floss (Appendix B)
  - ii. Reaction of silk, wool, and cotton hand embroidery floss to each dye color as each fiber will absorb dye differently (Appendix B)
  - iii. Use of iron as a color modifier
  - iv. Variety of physical resist dyeing techniques, such as Zha Jiao (binding), Feng Jiao (stitching), Jia Xie (fold and clamping), and pole -wrapping, onto silk and cotton fabrics; immersion of samples into natural dye using woad, madder, and turmeric
  - v. The possible colors that can be achieved through overdye with woad, madder, and turmeric dye extracts

- vi. Documentation of all steps with photographs and written notes, including any necessary comments for adjustments
  - b. Self-reflection and committee critique of work done on samples based on the following criteria:
    - i. Appropriate use of threads for each stitch
    - ii. Appropriate use of stitch on each fabric
    - iii. Effective use of overdyed for each stitch
    - iv. Effective color combination in color modifying and overdyed technique
    - v. Effective combination of embroidery and dyeing techniques
    - vi. Effective application of principles of design on surface design
- 3. Artifact Development
  - a. Application of findings to the design of apparel art forms that honors both modern and Chinese design aesthetics in the following ways:
    - i. Developed and edited illustrations for the possible garments for the collection
    - ii. Developed and selected illustrations and samples of embroidery for selected garments
    - iii. Developed patterns for selected garment designs for the collection
    - iv. Developed and completed selected garment designs with chosen combined embroidery stitches and resist dyeing techniques utilizing natural dye
  - b. Critique of final apparel designs by my major professor, Dr. Haar, and the committee who contributed feedback based on the following criteria:
    - i. Appropriate relationship to concepts of study (slow design, tradition, eco-efficiency)
    - ii. Effective combination of embroidery and dyeing techniques
    - iii. Effective application of principles of design for both surface design and garment design
    - iv. Quality of work
- 4. Exposition

- a. Exhibit outcomes in University exposition
- b. Submit outcome for juried review.

## **Chapter 4 - Design Exploration**

During the design exploration stage, I established various experiments to develop proper technique(s) for dyeing Chinese Su Xiu embroidery threads from cotton, silk, and wool flosses for selected woven fabrics. Having some tacit knowledge of natural fibers' reaction to dye color, I chose different weights of woven silk fabrics and a cotton fabric to provide diverse color combinations. Specifically, I selected the traditional Su Xiu fabric, silk habotai, along with silk organza and silk gauze. Also, I included cotton sateen not only to provide high fabric and floss color contrast but also to offer diverse design possibilities. Further, to increase complexity of sampling, fabric and floss were premordanted with various nontoxic chemicals.

Through exploration, I developed a group of fabric samples as well as a color library. With the aid of tacit knowledge, self-reflection, and critique, I analyzed the samples and came to critical findings. To demonstrate the process, this chapter discusses mordanting procedures and color library development. Also, the chapter covers embroidery stitches, physical resists, and technique procedures used on the samples.

### **Color Library Development and Dyeing Procedure**

To explore the possible range of colors, I developed a color library for madder, turmeric, and woad dye and prepared small fabric swatches and floss skeins. The color range was controlled by overdyeing with woad as well as premordant agents, including potassium aluminum sulfate (12% weight of fiber [WOF]), aluminum acetate (5% WOF), iron (5% WOF), and acid (5% WOF). Finally, madder cake extract and woad powder extract was purchased from Carol Leigh's Hillcreek Fiber Studio and turmeric from Nuts.com.

#### ***Premordant Procedure***

The flosses and fabrics were premordanted to enhance the bond between fiber and dye according to Wipplinger's (2005) mordanting formulas using potassium aluminum sulfate for protein fibers and aluminum acetate for cellulose fiber (Appendix E-F). To increase the color range of the selected fabrics and flosses, citric acid at 5% WOF was used to lighten color, and iron at 5% WOF was used to sadden or darken color. After

dissolving iron or acid, selected fabric or floss was immersed in a bath of water (80 °C) for 30 minutes, after which the fiber was rinsed in water and laid flat or hung to dry.

All fabrics and floss first were premordanted in groups of protein fiber and cellulose fiber. The cotton sateen fabric and cotton floss were premordanted using two separate baths (Appendix E). For all the silk fabrics and silk and wool flosses, I used the premordant formula for protein fiber (Appendix F). Then, all fabrics and floss were hung to dry. Notably, I separated the floss into a small skein and knotted it at one or both ends to prevent tangling in the baths.

### ***Madder and Turmeric Dyeing Procedure***

Prior to over dyeing with woad, the fabric swatches and floss skeins were immersion dyed with madder and turmeric. First, the swatches and skeins were fully soaked in room temperature water. Then they were immersed slowly into the madder or turmeric bath, allowing the fabric to move freely, and dyed for 60 minutes in hot water (82 °C) with frequent stirring to ensure even dye saturation. Here, madder cake and turmeric powder extract were calculated at 50% WOF. Finally, the swatches were rinsed under tap water, hand washed with textile detergent, and dried flat.

### ***Woad Dyeing Procedure***

In the woad-dyeing portion of the color library, to increase color range, swatches were manipulated with different premordants and woad dipping time increments (Table 4.1). As Chapter 2 discussed, woad is a vat dye that reacts with oxygen in its making and dyeing process. After a swatch was dyed in the madder or turmeric bath, it was dipped in the woad bath in increments of 5, 10, or 20 minutes to try to darken color over time. To achieve the proper woad dyeing technique, I followed Wipplinger's (2005) formula and procedures for Indigo vat dyeing (Appendix G).

First, woad stock needed to be prepared with 25 g of woad powder and 710 ml of water. Next, sodium hydroxide (lye) and thiourea dioxide (thiox) were added to dissolve and activate the woad. The woad stock was then dated and stored in the fridge. During the woad dye bath preparation, 237 ml of woad stock was dissolved in 3.4 L of water at different temperatures for protein and cellulose fibers (Appendix G). The bath color was

optimized by adding thiourea dioxide, and proper pH levels were checked for protein and cellulose fibers.

For dyeing the small swatches and skeins, the pieces were enclosed in a coffee filter and organized by dye treatment. First, each coffee filter sack with swatches was fully soaked in tap water and then dipped in woad for 5, 10, or 20 minute increments, coffee filter sacks were opened allowing oxidization. To finish, swatches were neutralized using the appropriate agents for protein and cellulose fiber (Appendix G). Finally, swatches were hand washed in hot water with textile detergent for 20 to 45 minutes and laid flat or hung to dry.



Table 4.1 Color library for fabric and floss using madder, turmeric, and woad dye (swatches used in further exploration shown in gray highlight).

Note: Aluminum acetate was used for cellulose fiber at 5% WOF and Potassium aluminum sulfate was used for protein fiber at 12 % WOF. Madder and turmeric extract amounts were 50% WOF.

<b>Madder Color Range</b>												
	Alum	5% Acid	5% Iron,	Alum			5% Acid + Alum			5% Iron + Alum		
		+ Alum	+ Alum	Woad overdyer	Woad overdyer	Woad overdyer	5min	10min	20min	5min	10min	20min
Silk habotai												
Silk organza												
Cotton sateen												
Silk gauze												
Wool												
Silk												
Cotton												
<b>Turmeric Color Range</b>												
Silk habotai												
Silk organza												
Cotton sateen												
Silk gauze												
Wool												
Silk												
Cotton												

Woad Color Range									
	12% Alum			5% Acid, 12% Alum			5% Iron, 12% Alum		
	5min	10min	20min	5min	10min	20min	5min	10min	20min
Silk habotai									
Silk organza									
Cotton sateen									
Silk gauze									
Wool									
Silk									
Cotton									

### ***Results and Analysis***

A few important observations were made from creating and examining the wide range of colors from madder, turmeric, and woad dye through over dyeing and pretreatment procedures. With self-reflection and committee member critique, I drew several findings based on the color library development.

The most critical finding was that the iron and acid pretreatments for both madder and turmeric were not visible after over dyeing with woad, despite applying the premordants to achieve a different depth of shade. However, the swatches dyed in the madder or turmeric baths alone showed a clear change in color shade. Meanwhile, most woad over dyed fabric and floss appeared very similar in color intensity (Table 4.1). Similar results also appeared in the swatches dyed in the woad bath alone. As a result, I concluded these additives did not serve their purpose in contributing to color diversity. Finally, since color change was visible in the madder and turmeric swatches not over dyed

with woad, clearly, the chemicals in the woad vat overpowered those of the iron and acid treatments.

The 5% WOF iron treatment was expected to darken the madder and turmeric dyed swatches, instead, the iron-treated swatches were more faded than darkened, most noticeably with madder. Although the lighter shade was not as expected, the results still showed a range of colors from light to dark values, which met the project's original intention to create a value change across fibers. In addition, of the selected fabric swatches, cotton sateen and silk organza performed best in the evenness of dye uptake and saturation, while the silk habotai swatches had less evenness of dyeing. Also, the shades from the turmeric appeared much brighter than expected and, thus, posed a challenge when designing apparel.

I did make some decisions based on the color library development. For instance, due to woad's ability to overpower the iron and acid pretreatment, I did not treat the fabric and floss with acid or iron for the woad overdye technique. The samples highlighted in gray in Table 4.1 show the colors that were used to guide further exploration.

### **Sampling**

During the design exploration stage, sampling of both embroidery and physical resist dyeing techniques was conducted using selected flosses and fabrics and natural dyes. First, embroidery was tested for floss compatibility and floss to fabric compatibility by applying selected stitches. Second, physical resist dyeing techniques were examined under madder and turmeric baths, woad overdye bath, and madder overdye bath. From the results, three techniques were developed and analyzed to prepare for the artifact development stage.

### ***Embroidery***

After the color range was determined, plans for embroidery sampling were adjusted accordingly. Consequently, seven Su Xiu stitches, including random stitch, single-variegated stitch, raised stitch, parallel stitch, seed stitch, spiral stitch, and shell stitch, were tested on silk organza, silk habotai, silk gauze, and cotton sateen and dyed in a madder, turmeric, and/or woad bath.

### ***Floss Compatibility***

To find the appropriate thickness of floss to stitch on selected fabrics, DMC<sup>®</sup> 2-ply cotton (size 5), Renaissance Dyeing 2-ply wool, and traditional Chinese 16-ply silk hand embroidery flosses were initially explored (Figure 4.1). Due to thread thickness, the cotton and wool flosses were parted to use 1-ply at a time, while all silk plies were left intact. However, due to the short staple of the 2-ply cotton fiber, the stitches did not lay smoothly (Figure 4. 2), so to achieve a balanced embroidery surface, DMC<sup>®</sup> 6-ply cotton floss (size 25) was used. This cotton floss was also separated to use 1-ply at a time (Figure 4.2). Although wool was parted to use 1-ply, it did not lay as flat on a fabric's surface as desired due to the fuzzy nature of the fiber. Also, 1-ply wool floss was much more fragile when handled and was time consuming to thread and stitch. Therefore, both plies of wool floss were used without separating plies to provide a smoother and more durable stitch surface. The binding of the two plies not only strengthened the fiber but also twisted it into thinner floss for stitching.

Figure 4.1 Chinese 16-ply silk embroidery floss (left); Renaissance Dyeing 2-ply wool embroidery floss (middle); DMC<sup>®</sup> 2-ply size 5 cotton embroidery floss (right).<sup>36</sup>



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<sup>36</sup> From [Photograph by Lushan Sun]. (2012)

Figure 4.2 Embroidery comparison between single-variegated stitch surfaces before (left) and after (right) change in thickness of cotton and wool flosses.<sup>37</sup>



### ***Floss and Fabric Compatibility***

The four selected fabrics were cut into small squares for embroidery sampling, after which, each stitch type was tested on each fabric to test compatibility. However, embroidering a raised stitch on silk gauze showed that this fabric structure was not appropriate for this type of surface treatment. The structure in the silk gauze was too weak and stretched extensively over the hoop, causing the embroidery pattern to lose its shape. Although single-variegated stitch and spiral stitch were possible to embroider on the silk gauze, they were very time-consuming and challenging to accomplish on this fabric. On the other hand, the silk habotai continued to serve as a fit background material for Su Xiu stitches. In fact, all stitch types performed well on silk habotai before dyeing. Also, the same result was apparent on cotton sateen (Table 4.2). In addition, the seed stitch and spiral stitch were both time consuming to apply on silk organza due to its semi-transparent loose weave. Moreover, seed stitch would require tying loose ends individually to prevent visible transitions on the backside of the fabric (Figure 4.3).

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<sup>37</sup> From [Photograph by Lushan Sun]. (2012)



Table 4.2 Su Xiu embroidery stitch critique.

Note: Y means yes or acceptable and N means no or not acceptable				
	Silk Habotai	Silk Gauze	Silk Organza	Cotton Sateen
Random stitch	Y	N	Y	Y
Single-variegated stitch	Y	N	Y	Y
Raised stitch	Y	Y	Y	Y
Parallel stitch	Y (only short/med length)	N	Y (only short length)	Y
Seed stitch	Y	N	Y (time consuming)	Y
Spiral stitch	Y	N	Y (best in density)	Y
Shell stitch	Y	N	Y	Y

Figure 4.3 Visible transitions for seed stitch on silk organza underside.<sup>38</sup>



Moreover, each stitched fabric sample was immersed in a dye bath to test embroidery durability after one or two treatments. After the madder and woad baths, the parallel stitches on silk organza and silk habotai became weak and distorted, which was especially visible with the silk floss (Figure 4.4). In addition to the handling during the dye bath, this was due in part to the weaker weave structure in silk organza and habotai. Ultimately, a short length parallel stitch would be appropriate on silk organza while a short to medium length parallel stitch would perform well on silk habotai. Fortunately, an

<sup>38</sup> From [Photograph by Lushan Sun]. (2012)

alternative option resolved the issue: to achieve the look of a parallel stitch with increased durability, a raised stitched can be used on both silk habotai and organza (Figure 4.5).

After receiving feedback and analyzing the embroidered fabric samples, I decided to eliminate gauze as a background medium for Su Xiu stitching. However, the silk gauze fabric was used in exploration of the physical resist techniques.

Figure 4.4 Parallel stitches on silk organza (left) and silk habotai (right) after madder and woad bath.<sup>39</sup>



Figure 4.5 Raised stitches on silk organza (left) and silk habotai (right) after madder and woad bath.<sup>40</sup>



### ***Physical Resist Dyeing***

For the physical resist techniques, four general types were sampled in madder, turmeric, and woad baths with all four fabrics: Zha Jiao (binding) and Feng Jiao (stitching), pole-wrapping, and Jia Xie (folding and clamping). Based on tacit knowledge, one technique was selected to apply to the appropriate fabric. First, cotton sateen, being tightly woven, was bound by wrapping thread around large nail heads. Having a stiffer weave structure, silk organza was folded and clamped in between wooden boards. Then, silk habotai, with

<sup>39</sup> From [Photograph by Lushan Sun]. (2012)

<sup>40</sup> From [Photograph by Lushan Sun]. (2012)

its natural drape, was wrapped onto a flexible aluminum foil duct. Finally, silk gauze was pleated diagonally and stitched tightly to secure the resist.

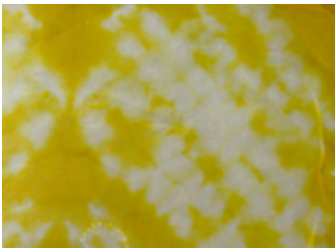
### ***Madder and Turmeric Bath Results***

The resisted samples were dyed in a madder bath for 60 minutes and then in a turmeric bath. The most pleasing results showed on silk organza, silk habotai, and cotton sateen with a distinct outline in the pattern created (Figure 4.6). However, the physical resist pattern on silk gauze was not as clear around the edges due to its loose weave structure (Figure 4.7).

Figure 4.6 Fold and clamp resisted silk organza dyed with madder.<sup>41</sup>



Figure 4.7 Stitch resisted silk gauze dyed with turmeric.<sup>42</sup>



### ***Woad Overdye Bath Results***

Previously mentioned samples (Figure 4.2-4.7) were stitched based on the resist pattern and overdye in a woad bath along with other non-resisted embroidery samples, which yielded the inspiration to change the dye times. First, a red-brown color was achieved on the folded and clamped silk organza by dipping the samples in a woad bath for 5 seconds. Next, a gray-black color resulted when madder-dyed silk organza was

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<sup>41</sup> From [Photograph by Lushan Sun]. (2012)

<sup>42</sup> From [Photograph by Lushan Sun]. (2012)



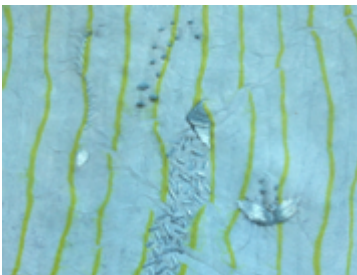
dipped in woad for 1 minute. Although 5-second and 1-minute increments of woad overdyer were not sampled in the color library, the technique provided rich colors and was used in later technique applications (Figure 4.8).

Figure 4.8 Fold and clamp resisted and embroidered silk organza dyed with madder and overdyed with woad.<sup>43</sup>



The samples embroidered post physical resist dyeing in either the madder or turmeric baths did not show a high contrast between floss and fabric colors. However, the embroidered samples, previously dyed in madder, received high color contrasts between fabric and floss after the woad overdyer (Table 4.3, Type III). On the other hand, the turmeric dyed samples were not as visually pleasing (Figure 4.9). For example, overdyeing the turmeric yellow in woad resulted in a blue-green color combination, and the embroidery stitching was barely visible. As shown in Figure 4.9, the color contrast between floss and fabric was low. In this group, the least satisfactory sample was done on stitched silk gauze.

Figure 4.9 Resisted and turmeric dyed silk habotai was then embroidered to overdyer in woad bath.<sup>44</sup>



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<sup>43</sup> From [Photograph by Lushan Sun]. (2012)

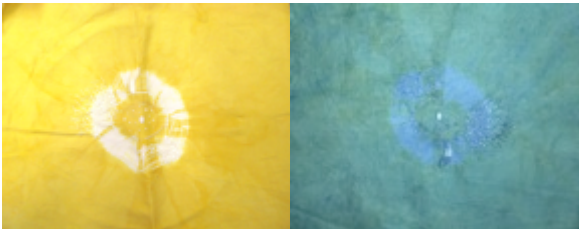
<sup>44</sup> From [Photograph by Lushan Sun]. (2012)

Next, physical resist techniques were selected by evaluating the woad overdye samples. Initially, the four physical resist techniques applied to the four fabrics resulted in a clear resist pattern with a distinctive outline. However, the Feng Jiao (stitching) and Zha Jiao (binding) techniques did not continue to provide as much clarity and distinct outline of the patterns on the fabric. Unlike the sample seen in Figures 4.8 and 4.9, the resist patterns in Figures 4.10 and 4.11 appear more blurred and undefined post woad overdyed. Thus, this outcome is not compatible with embroidery applications.

Figure 4.10 Comparison of stitched and resisted silk gauze before (left) and after (right) woad overdyed.<sup>45</sup>



Figure 4.11 Comparison of bound resisted silk gauze before (left) and after (right) woad overdyed.<sup>46</sup>










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<sup>45</sup> From [Photograph by Lushan Sun]. (2012)

<sup>46</sup> From [Photograph by Lushan Sun]. (2012)

Table 4.3 Order of operations for applying embroidery and various physical resist dyeing techniques.

Notes:			
<ul style="list-style-type: none"> <li>All flosses were premordanted, and some were treated with acid or iron</li> <li>All fabrics were premordanted and could be treated with acid or iron</li> <li>Steps are numbered by type of natural dye bath</li> </ul>			
<b>Single Dye Bath</b>			
Type I 	1. Embroider fabric, resist fabric, dye fabric with madder		
<b>Woad as Overdye</b>			
Type II 	1. Resist fabric, dye fabric with madder 2. Embroider fabric, overdye fabric with woad	Type III 	1. Embroider fabric, dye fabric with madder 2. Overdye fabric with woad
<b>Madder as Overdye</b>			
Type IV 	1. Resist fabric, dye fabric with madder 2. Embroider fabric, overdye fabric with woad 3. Overdye fabric with madder	Type V 	1. Dye fabric with madder 2. Resist fabric, overdye fabric with woad 3. Embroider fabric, overdye fabric with madder
Type VI 	1. Dye fabric with woad 2. Embroider fabric, resist fabric, overdye fabric with madder	Type VII 	1. Embroider, fabric resist fabric, dye fabric with woad 2. Overdye fabric with madder

***Madder Overdye Bath Results***

Some decisions were made in response to the less satisfying outcomes in the turmeric and woad dyed samples. For instance, while woad was traditionally used as overdye, madder was used here instead to provide more color contrast between the fabric and floss on samples such as Figure 4.6. That sample received its third bath with madder and was overdye for 60 minutes, using the same madder dyeing technique mentioned

previously (Figure 4.12). Obtaining a high color contrast between the floss and fabric, the outcome inherited more elements from Su Xiu. This process also introduced a new technique, namely using madder as an overdye to increase or adjust the color range. However, the cotton floss did not receive enough madder dye to overpower the blue color from the woad. This may have been caused by the special finishing commercially applied to the cotton fibered floss surface. The other less satisfying result was that this process was rather complex and not time and energy efficient given the three separate dye baths: turmeric, woad, and madder (Table 4.3, Type IV).

Figure 4.12 Turmeric dyed and embroidered silk habotai overdyeed in woad and madder.<sup>47</sup>



Upon completion of the procedures I—IV, three additional samples were made to further explore the various orders of operation in applying embroidery and physical resist techniques (Table 4.3). The Type V order of operation was applied to the silk organza, also with three dye baths. Fabric was first dyed with madder, then treated with a pole-wrap resist and overdyeed with woad. In the third step, the fabric was embroidered and overdyeed with madder. Like Type IV, this procedure was complex with low visibility on its resist pattern. Further, the Type VI order of operation consisted of two baths. Fabric was first dyed with woad, then embroidered, pole-wrap resisted, and overdyeed with madder. This procedure was rather simple and most effective in its use of techniques.

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<sup>47</sup> From [Photograph by Lushan Sun]. (2012)

Type VII was the last madder overdye order of operation that was explored. It also required two baths, in which the fabric was first embroidered, pole-wrap resisted, and dyed with woad before being submitted to the madder overdye. Similar to the Type V result, this outcome did not show a clear resist pattern. However, it was interesting to see a yellow-green tone on the embroidery and fabric (Table 4.3). Using madder exhaust baths, which are weaker, may have caused these colors. This discovery again broadened the color range by combining madder and woad dyeing.

### **Technique Development and Analysis**

After the technique exploration stage, my major professor and committee members reflected upon the results and critiqued them. Based on the criteria posed in the initial objectives, the results were reviewed with appropriate relationship to concepts of the study, effective combination of embroidery and dyeing techniques, and effective application of principles of design. A critique rubric was established to analyze the characteristics of the seven techniques explored (Table 4.4).

This project attempted to achieve two principles of slow design, inheriting tradition and maintaining eco-efficiency. Chinese Su Xiu was inherited through the floss to fabric contrast, color range, and embroidery evenness. Also, the embroidery was created in combination of traditional physical resist dyeing techniques. To reflect eco-efficiency, the technique must indicate effective and efficient application of techniques and material usage. A few types shown in Table 4.4 achieved one or the other while some realized both principles. Importantly, the samples shown in this table are only representative of the technique and do not necessarily reflect all aspects of illustrated techniques. Also, the categories listed were graded on a scale of 1 to 5 with 5 being “most satisfactory.”

Next, Type II and VI techniques only maintained eco-efficiency through the use of two dye baths, while Type IV and V addressed inherited embroidery color range and high color contrast from floss to fabric. However, the satisfying color result was only attained through complex procedures and by sacrificing the eco-efficiency principle (Table 4.4).

On the other hand, the Type I, III, and VI techniques supported both slow design principles (Table 4.4). Type I only consisted of one dye bath, incorporating both embroidery and physical resist techniques. Although only warm colors were available through this technique, the outcome shows a strong color contrast between floss and fabric. On the other hand, Type III offers both warm and cool colors in floss to fabric contrast. Also, with the cotton floss, a warm to cool color range was achieved after the woad overdye bath. However, the most successful sample was accomplished with the Type VI technique, which included both the embroidery and physical resist elements. While the physical resist pattern was not as visible as it might be, it could be improved by an extended madder overdye. Finally, although only warm colors were present in the embroidery, the floss to fabric contrast resulted in warm to cool colors. Despite the evident imperfections in the three techniques, the outcome encouraged and inspired me to proceed to the final artifact development.

Table 4.4 Critique of explored techniques with the selected techniques highlighted.

Type/ example	Supported principle	Floss/ fabric color contrast	Floss color range	Dye bath	Pros	Cons
Type I 	Eco- efficiency, Inheriting tradition	Warm-warm	Warm-warm	1	One bath, can include physical resist	Lack cool colors
Grade	5	4	4			
Type II 	Eco- efficiency	Cool-cool or Warm-cool	Cool-cool	2	High visibility in resist pattern	Lack floss/ fabric contrast
Grade	3	3	2			
Type III 	Eco- efficiency, Inheriting tradition	Warm-cool or Cool-cool	Warm-warm Warm-cool	2	High color contrast in floss/ fabric	Only works well on cotton & organza
Grade	4	5	4			
Type IV 	Inheriting tradition	Warm-warm or Warm-cool	Warm-warm or Warm-cool	3	High floss/ fabric color contrast	Complex procedures
Grade	4	5	3			
Type V 	Inheriting tradition	Warm-warm or Warm-cool	Warm-warm	3	Alternative surface design	Complex procedures, unclear resist pattern
Grade	2	2	2			
Type VI 	Eco- efficiency, Inheriting tradition	Cool-warm or Warm-cool	Warm-warm	2	High floss/fabric color contrast, visible resist	Lack cool color on embroidery
Grade	5	5	4			
Type VII 	Eco- efficiency	Warm-warm or Warm-cool	Warm-cool	2	Alternative surface design	Low visibility in pattern
Grade	3	3	4			

## **Summary**

In the stage of design exploration, twenty-seven fabric samples were tested with the techniques of Su Xiu stitches and physical resist dyeing techniques (Jiao Xie) using madder, turmeric, and woad dyes. The techniques explored were self reflected, committee member critiqued, and analyzed using the established criteria. Moreover, a color library was developed for each natural dye in both fabric swatches and floss skeins, and the dyeing techniques were carefully sampled. Due to the nature of woad dye to overpower the acid and iron mordant, a range of woad overdyed colors was excluded. Also, Zha Jiao (binding) and Feng Jiao (stitching) physical resist techniques were eliminated due to lack of visibility in resist pattern post woad overdye. Finally, Type I, III, and VI techniques were adapted to meet slow design principles of maintaining eco-efficiency and inheriting culture.

### ***Material Elimination***

Through exploration and critique, I made the decision to eliminate turmeric dye and silk gauze. First, in the embroidery sampling, silk gauze was least satisfactory in its compatibility with the Su Xiu stitch. Moreover, it did not show a clear contrast in the resist pattern of the physical resist sampling. Next, the turmeric dye was eliminated for two reasons. The samples showed strong neon yellow colors that were not congruent with my design aesthetic. Additionally, without turmeric dye, yellow tones were accessible with a madder exhaust bath.



## **Chapter 5 - Artifact Development**

The overarching aim of this project was to sustain traditional art through slow design. Specifically, the main objective was to reinterpret Chinese embroidery, Su Xiu, by combining physical resist dyeing techniques utilizing natural dye. Through sampling, critique, and analysis, I chose three techniques combining embroidery and physical resist dyeing, and included three garments in the final apparel group to reflect the three developed techniques. Additionally, a few important steps were instrumental in achieving the final group of artifacts and are discussed in this chapter. First, my inspiration for the final garments was refined according to research of Chinese influenced design elements. Then, the process of design creation was adjusted based on the initial design process model. Finally, technique application, design adjustment, and challenges of each garment produced are presented.

### **Inspiration Refinement**

As I refined my inspiration, I considered the influence of the Chinese designs I had researched. In addition, water emerged as primary inspiration for the final garments from the elements I researched.

### ***Chinese Influenced Design***

As Chinese culture becomes more popular globally, many apparel and textile designers are favoring its design elements. For example, traditional Chinese silhouettes, colors, and patterns have become highlighted elements in Western design and are being recreated through diverse techniques and concepts (Figure 5.1). Today, the fusion of traditional and modern designs often translates into fashionable design. As Chinese design elements continue to capture the world's attention, sustainable concepts have also become influential in the world of apparel and textiles. With slow design principles reminiscent of inherited tradition and eco-efficiency in mind, I developed an apparel group for this project that communicates modern interpretation of traditional Chinese textile art using natural dye.

When designing this apparel group, I considered Chinese design elements and enhancements of surface design features. Thus, simple silhouettes were utilized to provide a foundation for the embroidery and physical resist patterns.

Figure 5.1 Chinese influenced modern apparel.<sup>48</sup>



### ***Water Inspiration***

After researching and exploring Chinese design elements, I was drawn to images of various textures, mood, and color; in particular, the final overall inspiration came from dye color, fabric, and water movements.

Initially, I was intrigued with the striking copper red, red-brown, and gray-black shades that madder and woad produced on silk organza. These shades formed a harmonious ombré-like overall appearance when layered together from light to dark. They also determined the main color story of this apparel group, which included shades of blue and beige that can be found in Chinese design elements, landscape, and movement (Figure 5.2-5.4).

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<sup>48</sup> From website <http://www.fashionwindows.net/2011/02/vivienne-tam-fall-2011/fashion-vivienne-tam-2/>  
[http://runwaystroll.blogspot.com/2010\\_08\\_01\\_archive.html](http://runwaystroll.blogspot.com/2010_08_01_archive.html)  
<http://fashiontribe.net/?p=189>  
<http://www.fashionjunkii.com/Blanc-de-Chine-SS2010-presentation-5813028>  
<http://www.fashionwindows.net/2011/02/vivienne-tam-fall-2011/fashion-vivienne-tam-11/>

Figure 5.2 Traditional Chinese design elements: color and texture.<sup>49</sup>



Figure 5.3 Traditional Chinese design elements: lightness<sup>50</sup>



<sup>49</sup> From website <http://mycollect.net/blog/761496>

Zhou, K. (2003). 丽江[Lijiang]. p67.

Tam, V. *China Chic* (2000).p4.

Zhou, K. (2003). 丽江[Lijiang]. p59, p36.

<sup>50</sup> From website <http://bestdesignoptions.com/?p=11638>

<http://allyrose.wordpress.com/2007/10/14/living-torso/>

<http://www.yidaba.org/html/sheying/2010-12/1385p2.htm>

<http://www.yidaba.org/html/sheying/2010-12/1385.htm>

<http://jishi.xooob.com/wh/200811/356039.htm>

Tam, V. (2000).*China Chic* Harper Collins Pub. New York, p1, p174.

Figure 5.4 Traditional Chinese design elements: landscape<sup>51</sup>



A key objective was to develop modern embroidery patterns using Su Xiu techniques. However, instead of regenerating the patterns and common subjects from traditional Su Xiu, I drew from the idea of water, researching images of water to try to create a progressive movement that illustrated its rhythm (Figure 5.5). It was important not only as a source of inspiration for the designs but also as the key medium in dyeing. As I mentioned in Chapter 2, in Chinese, the character dye (染) is written combining three characters: water, wood, and the number nine. Therefore, since water plays an important role in the history of dyeing, my idea was to incorporate a different water movement or rhythm into each garment through the applications of physical resist, embroidery, and natural dye colors. Building on this theme, the chapter also discusses individual garment inspiration.

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<sup>51</sup> From Qian, B. (2003). *情醉南通 [Love to hometown]*. p38.  
Tam, V. (2000). *China Chic*. px.  
Qian, B. (2003). *情醉南通 [Love to hometown]*. p2.  
Tam, V. (2000). *China Chic*. p152.

Figure 5.5 Various forms of water.<sup>52</sup>



## **Design Establishment**

Design establishment includes production procedures of each garment design and the process model used. During this step, I initially used a linear design process flow and found it inappropriate in this project. When challenges and unexpected events emerged during production, I made design adjustments that influenced following procedures. As a result, a progressive design process flow was adopted. In addition, this section discusses design process changes in terms of inspiration, technique application, and construction.

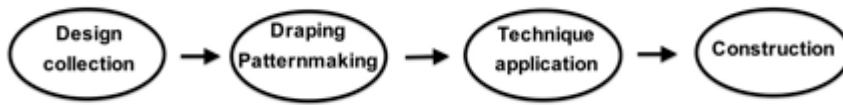
### ***Design Process***

In this practice-based research, a linear design process was initially applied to reflect the typical stages in apparel design (Figure 5.6). Therefore, at first, a collection of apparel was developed based on predetermined inspiration. The colors and fabric choices as well as the embroidery designs were also roughly planned out for all of the garments. Then, draping and patternmaking were to be completed before the technique was applied finally to the fabric. Construction of all the garments simultaneously was expected to be the last stage. However, shortly after applying the techniques to the first garment, I encountered challenges. I found that my predetermined design collection did not group cohesively with the first garment in color and silhouette. As a result, the remaining designs were adjusted accordingly.

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<sup>52</sup> From website <http://bestdesignoptions.com/?p=11638>  
<http://socalwater.com/about>  
<http://bonfirehealth.com/water-facts-consumption-digestion-elimination-circulation-skin/>

Figure 5.6 Linear design process flow.<sup>53</sup>

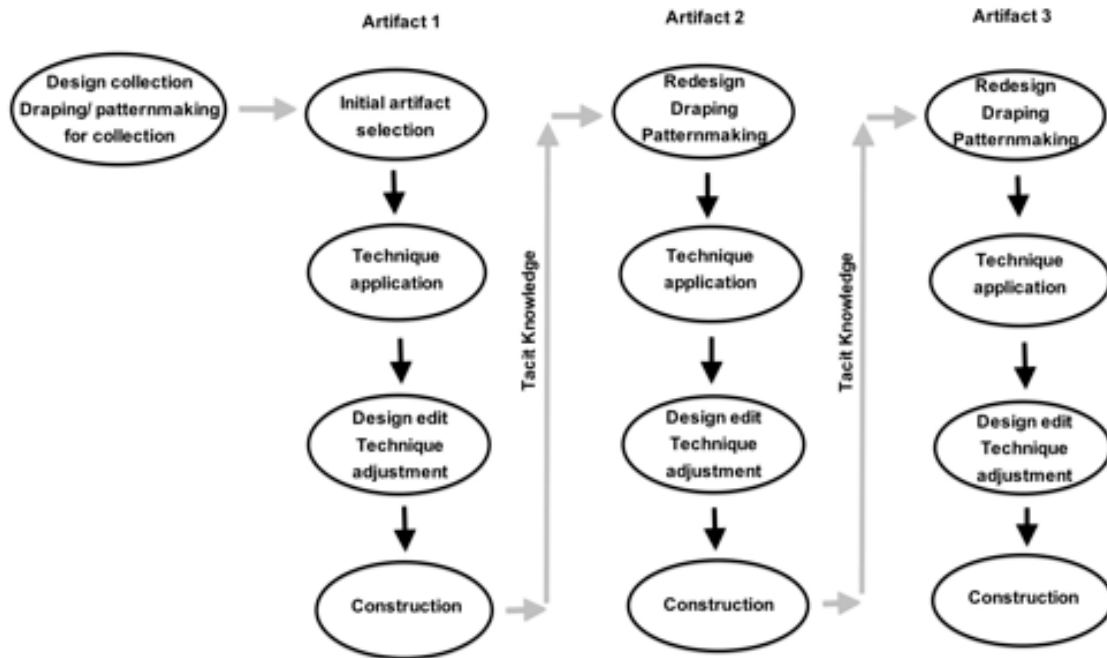


This project required realizing that designing with limited expertise is designing at risk such that events can occur at the most unexpected times. To proceed, I had to make decisions to edit designs and adjust techniques after technique application. Fortunately, I was able to utilize experience and inspiration gained from previous garment development to create the remaining garment designs. Consequently, I adopted a progressive design process to accommodate unexpected events or procedure error in this practice-based research (Figure 5.7). In this flow, each garment stimulated the next in a progressive manner throughout the process. For instance, when developing the second and third garments, I altered designs almost entirely to achieve cohesion with the previously completed garment. Thus, draping and patternmaking were either adjusted or recreated in this process.

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<sup>53</sup> From [Figure by Lushan Sun]. (2012)

Figure 5.7 Progressive design process flow.<sup>54</sup>



### *Designs*

This section covers the design development of three garments from specific inspiration, technique applications, design adjustment and challenge, to construction. In designing these garments, I kept style lines simple to allow the focal point to fall on the surface design of embroidery and physical resist patterns. All of the selected fabrics and flosses were pretreated according to Wipplinger’s (2005) formula for mordanting (Appendix E-F).

#### *Naturally Refined Series: Rippled*

I began developing the final artifacts with the simplest and least structured silhouette from the initial collection using silk habotai and silk organza. The technique applied in this garment demonstrated Type I technique (Table 5.1). The fabric was first embroidered then dyed with madder. Then the pole-wrapping technique was applied to create texture.

<sup>54</sup> From [Figure by Lushan Sun]. (2012)

### **Inspiration and Design**

This garment drew inspiration from images of water drops as the intention was to create a dress that communicated a tranquil mood. As a result, it took advantage of the natural drape in silk habotai designed with a tent silhouette to drape loosely on the form. The garment consists of a yoke with wide jewel neckline across both the front and back upper bodice in silk organza. Side and center panels of silk habotai are attached to the yoke and divided the negative spaces in the garment to create positive spaces for the embroidery detail. The side panels are seamed at dropped waist, while the center panel is gathered and floor length. The back pieces are the same, except for the yoke, which is in two pieces to create a slim keyhole opening with frog closure. Finally, a one-inch wide sash in silk organza was added to define the normal waistline, thus creating a slender and delicate look.

Embroidery was designed on the front bodice to reflect the image of delicate water drops landing on a flat surface. The skirt portion was treated with pole-wrapping to achieve a ripple-like pattern at the hem. By contrasting the positive spaces on the bodice and the skirt bottom with ombré on the center front panel, the garment could enhance the calm mood with a slight change in motion.

### **Draping and Patternmaking**

Before the techniques were applied, individual pattern pieces were first draped on a mannequin in muslin then transferred onto paper accordingly. The paper pattern was marked with grain line, notches, seam allowances and other such markings to guide the later construction process. Each fabric piece was numbered as a specific pattern piece to prevent possible confusion during dyeing.

### **Technique Application: Embroidery**

All silk habotai pieces in this garment, *Rippled*, were first premordanted with iron at 5% WOF, and then two pieces of silk habotai were cut and traced with the appropriate pattern to indicate the area for embroidery. Then, they were stretched onto the traditional embroidery frame ensuring even tension on the embroidery surface (Table 5.1). The embroidery in this garment included parallel, random, and raised stitches to illustrate the stylized water drops. From dark to light, the embroidery was designed in a diagonal, top



to bottom transition, which reflected the similar ombré effect seen in the skirt portion of the garment (Figure 5.8). Negative space was utilized to aid in the overall flow of the embroidery design. As a result, the placement of the selected stitches provided an effortless organic look for this garment.

Table 5.1 Technique application of Naturally Refined Series: Rippled.


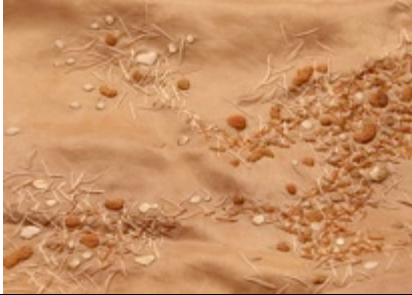


<b>Order of operation: Type I —1. Embroider fabric + Dye fabric in madder</b>	
Embroider fabric (iron premordant) 	Dye fabric in madder 
<b>Physical resist and dyeing techniques using madder dye</b>	
Pole-wrapping (iron premordant) 	Ombré (iron premordant) 

Figure 5.8 Naturally Refined Series: Rippled embroidery detail on front bodice side panel.<sup>55</sup>



<sup>55</sup> From [Photograph by Lushan Sun]. (2012)

### **Technique Application: Physical Resist and Dyeing**

To balance the proportion of the physical resist patterns with the embroidery, negative spaces were enhanced by applying ombré. To create the ombré effect, silk habotai was dipped into a madder bath horizontally at the desired portion for one minute. The bottom of the dress, from hem to knee, was then pole-wrapped and dyed with madder. The ombré applied was a simple and effective way not only to enhance the mood in this design but also to enhance the level of color saturation in pole-wrapping resist patterns (Table 5.1).

The wrinkled texture formed on the silk habotai from the pole-wrapping technique created an interesting rippled effect; moreover, it seemed natural to preserve the texture to enhance the overall theme of this garment. In finishing, the pole-wrapped fabric pieces were only washed in water with textile detergent and dried to retain the texture.

### **Technique Adjustment and Design Edit**

One key step to mention was the unexpected event when dyeing silk organza. The initial intention was to achieve the gray-black color from madder overdyed with woad. However, dipping the silk organza into a woad bath resulted in a rich shade of navy blue (Figure 5.9). The original samples dyed in a madder bath used 50% madder dyestuff. In this project, the formula was miscalculated and amounted to 5% madder dyestuff. Thus, the resulting color from the madder bath was not as strong as the intended shade of gray-black after the woad overdye. Although this result was unplanned, the color paired well with the beige and copper shades found in the rest of the garment.

### **Construction**

For this garment, the bodice side panels were underlined with undyed silk habotai leaving the rest of the dress unlined. French seams, which encase the seam allowance, were applied to all seams. Only one problem was encountered during construction; the edge of the silk organza used for the shoulder yoke was difficult to finish at the neckline and armholes due to the fabric's loose weave and stretch in areas of bias (i.e., armhole curve). Therefore, after testing several types of stitches, an overcasting stitch was used.

Figure 5.9 Naturally Refined Series: Rippled, front (left) and back (right).<sup>56</sup>



#### Naturally Refined Series: Rippled

- Fabric: silk habotai, silk organza
- Embroidery floss: silk, wool, cotton
- Embroidery stitch: parallel, random, raised
- Premordant: 12% aluminum sulfate (all fabrics), 5% iron (silk habotai)
- Natural dye: 50% madder, woad
- Order of operation: Type I—1. Embroider fabric, dye fabric in madder

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<sup>56</sup> From [Photograph by Lushan Sun]. (2012)

### ***Naturally Refined Series: Disturbed***

Realizing the colors from the first garment did not result in the intended shades, I redesigned the second garment using elements from the initial design sketches and added new ideas to provide cohesiveness. The second garment, *Disturbed*, was produced in silk organza and cotton sateen. Two types of order of operations were applied: Type I and III. Type I technique consisted of embroidering fabric, resisting fabric, and dyeing fabric in a madder bath (Table 5.2). Type III technique required two dye baths following embroidery: dye in a madder bath then overdyeing in a woad bath (Table 5.2).

### ***Inspiration and Design***

From the ripple effect to the disturbed effect, the garments should illustrate a transition of mood and rhythm. So, given that as water increases its movement, a splash can form with a wave of rings that extend outward, I translated forms of water splash into embroidery patterns on this garment. To communicate the motion of a splash, I utilized the folding and clamping technique to create a pointed teeth-like pattern to reflect the embroidery design. When designing this garment, I became increasingly inspired by the cooper-red and gray-black shades and the stiff woven structure found in the silk organza exploratory samples. Thus, I adopted a more structured silhouette for this garment using gathers to create a rounded silhouette. Meanwhile, the colors were highlighted through folding and layering of the silk organza. In turn, the style lines created with these design details further enhanced the motion of water rings radiating outward.

This garment consisted of a strapless gown with an empire waist silhouette and a side seam closure. The front and back bodice consisted of three stacked layers of folded silk organza, each in a different shade. The outer layer was accentuated with embroidery and folding and clamping patterns. The bodice was connected to a contoured high waist yoke that drew the eye to the focal point of the embroidery of water splash. To intensify the overall theme, I designed the skirt portion with an uneven hemline in two layers of silk organza with the front falling at knee level and the back draping to the floor. The top layer of the skirt was strategically designed with the same folding and clamping pattern seen on the bodice. As a result, the theme of this garment was manipulated by the color, texture, and natural stiff hand of the selected fabrics and by embroidery and construction techniques.

### **Draping and Patternmaking**

For this garment, initial pattern pieces for this garment were partially recreated or adjusted through draping and patternmaking to reflect the new design. Draping fabrics were chosen for their similar weight and hand compared to the fashion fabrics. For example, muslin was used where the cotton sateen fabric would be and sheer organza fabrics were used where the silk organza would be in the final garment. In this way, the draping fabrics responded similarly to the final fabrics. Individual draped fabric pieces were transferred to a paper pattern, and all fashion fabrics were cut according to the final pattern. To be embroidered, pieces were cut in a large rectangle shape to allow for embroidery frame attachment. Then, to prepare for dyeing, each fabric piece was marked for specific design detail and coded to prevent confusion in handling.

### **Technique Application: Embroidery**

Similar to the first garment, the precut and marked cotton sateen piece was stretched onto a traditional embroidery frame (Table 5.2). Then, the water splash design was hand drafted in pencil and shaded at specific areas indicating darker colors. To increase the range of the water splash design on the cotton sateen waist yoke, a pear-shaped pattern was designed around the water ring and extended onto the folded silk organza layer of the bodice (Figure 5.10). Four stitches were strategically planned for the fabric surface: parallel, single-variegated, spiral, and random stitches. The spiral stitch transitioned the curves while the single-variegated stitch smoothed the transition between different shades of color. Moreover, since, as previously mentioned in Chapter 4, the blue color from the woad dye overpowered the pink shades in cotton floss, I designed a layer of random stitches in cotton fibers as the embroidery background to provide a shadowed and textured effect on the cotton sateen. As a result, a blue color was visible on the cotton floss after the woad overdye bath and contrasted with the yellow-brown colors in the silk and wool floss (Figure 5.10).

With selected stitches, the embroidered waist yoke and folded bodice layer illustrated an image of water splash and served as a positive space that balanced harmoniously with the negative spaces in the rest of the garment. Also, the placement of water drop patterns around the water splash pattern led the eye to look outward (Figure 5.10). Through this composition, the eye was able to not only view vertically but also

radially around the bodice yoke. Consequently, the composition reflected the intended theme and mood in this garment.

Table 5.2 Technique application of Naturally Refined Series: Disturbed.




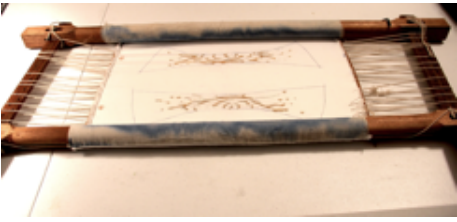


<b>Order of operation applied: Type I—1. Embroider fabric, resist fabric, dye fabric in madder</b>	
Embroider fabric 	Folding and clamping 
Dye fabric in madder 	
<b>Order of operation applied: Type III—1. Embroider fabric, dyed fabric in madder 2. Overdye fabric in woad</b>	
Embroider fabric 	Dye fabric in madder 
Overdye fabric in woad 	



Figure 5.10 Naturally Refined Series: Disturbed embroidery and fabric detail on front (top) and back (bottom) bodice.<sup>57</sup>



***Technique Application: Physical Resist and Dyeing***

During the dyeing process of the second garment, *Disturbed*, the folding and clamping technique was applied in two simple steps to enhance the embroidery pattern of water splash. First, the silk organza piece for the bodice was folded in half and pleated at

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<sup>57</sup> From [Photograph by Lushan Sun]. (2012)

one inch intervals. Then, it was positioned diagonally in between two wooden boards, leaving 2/3 of the fabric length loose for dyeing in a madder bath (Table 5.2). As a result, a pointed teeth-like pattern emerged.

Next, the physical resist applied to the bodice helped to frame the embroidery design (Figure 5.10). To further highlight the focal point of the garment, the same resist technique was applied at the top layer of front and back skirt hem without folding the fabric in half. Then, when the resist was released and fabrics were unfolded after the madder bath, the result was a red-orange color instead of the intended copper-red color (Figure 5.11). To attain the desired color, I attempted to refold the madder dyed fabrics to its original crease and resist again for extended dyeing in madder bath. After the second madder bath, these resisted fabric pieces were overdyed in woad for five seconds to achieve a rich brown color (Figure 5.12). Due to the inaccuracy in refolding and resisting the fabrics for the second madder bath, the outline of the resist pattern was not sharp and distinct. This consequence resulted in an ombré effect, in which the red-orange color from the initial madder bath was still visible under the brown color (Figure 5.12). Fortunately, this unplanned event resulted in a design detail that strengthened the overall color combination and mood of this garment.

Figure 5.11 Naturally Refined Series: Disturbed red-orange color on skirt front achieved from initial madder bath with folding and clamping technique.<sup>58</sup>

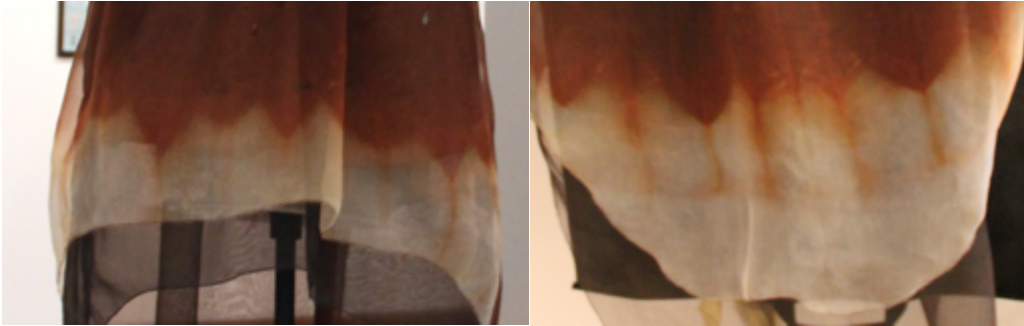


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<sup>58</sup> From [Photograph by Lushan Sun]. (2012)



Figure 5.12 Naturally Refined Series: Disturbed folding and clamping resist detail on skirt front (left) and back (right) after madder bath and woad overdye bath.<sup>59</sup>



On the other hand, the dyeing process for other parts of the garment was less challenging. The silk organza layers for front and back bodice were all dyed in madder bath for one hour after which those layers showed two darker colors achieved through woad overdye. Then, the second layer was dipped in a woad bath for 5 seconds to achieve a brown color while the third layer was dipped in a woad bath for 1 minute to create a blue-black color (Figure 5.10). The outcome revealed a coherent group of colors that formed a unique ombré effect for the garment bodice.

#### ***Technique Adjustment and Design Edit***

In the process of developing this garment, I overcame many obstacles and made several critical findings. First, while dyeing the silk organza for the second layer of skirt, the gray-black color was difficult to achieve. According to the formula from the exploratory sample, this color was achieved from overdyeing woad on madder-dyed silk organza. This may have been caused by a miscalculation of dyestuff for the previous madder bath. Also, as previously mentioned, the copper-red color did not reach its desired shade from the first madder bath. Instead, when it was dipped in a woad bath, it resulted in an olive-like color. To resolve this issue, the fabrics were brought back into a madder bath for an additional hour to achieve the desired gray-black color with close time monitoring (Figure 5.13). From this, I learned that the madder bath can adjust or correct dye color on fabric that was overdye with woad.

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<sup>59</sup> From [Photograph by Lushan Sun]. (2012)

Figure 5.13 Before and after comparison of silk organza applying madder overdye to darken shade post woad overdye.<sup>60</sup>



Similarly, madder was used as an overdye to correct the less satisfactory result on the embroidered bodice yoke pieces. As noted in the analysis in Chapter 4, it is essential to create embroidery that contrasts with the background fabric color to reflect the traditional character of Chinese Su Xiu. For the bodice yoke pieces, the intended goal was to achieve yellow-brown embroidery contrasting with medium blue cotton sateen fabric. However, after a one hour madder bath and a five-minute woad overdye bath, the samples revealed blue shades of embroidery against medium blue fabric (Figure 5.14). However, by using madder as overdye, the color outcome was successfully adjusted revealing olive-yellow embroidery against blue-gray fabric (Figure 5.14). This result also suggests that madder overpowers the blue color from woad overdye and could be used as an additional overdye to retrieve intended dye color. In this case, the madder overdye provided flexibility for practice-based research while placing fewer restrictions on the order of operation for the dyeing procedure.

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<sup>60</sup> From [Photograph by Lushan Sun]. (2012)

Figure 5.14 Before (left) and after (right) comparison of cotton sateen bodice yoke pieces in applying madder overdye to brighten embroidery post woad overdye.<sup>61</sup>



The creation process entered a vigorous brainstorming phase as unexpected events occurred during dyeing. In response, the initial design was edited accordingly. At the same time, mentor critique contributed significantly to making appropriate decisions about editing. This was especially helpful when the initial vision was hard to achieve because some dye colors were not successfully attained during the primary dyeing attempt. Ultimately, an assortment of dyed fabric pieces were either paired or grouped to create various color combinations for possible designs in an attempt to maintain the initial vision that was in cohesion with the first garment. Fortunately, the solution of overdyeing with madder enabled the design vision to be carried out satisfactorily (Figure 5.15).

### **Construction**

The construction of this garment, *Disturbed*, was simple and straightforward. I did not face as many challenges as I did during the redesigning and technique application process. This garment was lined with silk habotai at the bodice and bodice yoke, and an invisible zipper was sewn to the right side seam to provide garment closure. The cotton sateen underskirt served as a lining layer for the skirt portion. The side seams of the cotton sateen underskirt were completed using welt seaming, and the side seams of the silk organza skirt layers were sewn with French seaming to prevent fraying. However, it was challenging to finish the edges of the silk organza layers due to the loss of woven structure. Thus, straight stitching topped with small overcast stitching was applied to all silk organza hems.

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<sup>61</sup> From [Photograph by Lushan Sun]. (2012)

Figure 5.15 Naturally Refined Series: Disturbed, front (left) and back (right).<sup>62</sup>



Naturally Refined Series: Disturbed

- Fabric: cotton sateen, silk organza, silk habotai (lining)
- Embroidery floss: silk, wool, cotton
- Embroidery stitch: parallel, random, single-variegated, spiral
- Premordant: 12% aluminum (protein fiber), 5% aluminum acetate  
(cellulose fiber)
- Natural dye: 50% madder, woad
- Order of operation: Type I—1. Embroider fabric, resist, dye fabric in madder  
Type III—1. Embroider fabric, dyed fabric in madder  
2. Overdye fabric in woad

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<sup>62</sup> From [Photograph by Lushan Sun]. (2012)

### ***Naturally Refined Series: Unsettled***

Completing the *Rippled* and *Disturbed* designs meant I could start the final design of the apparel collection. In the initial design ideas, the third garment was to communicate an unsettled mood that illustrated another form of water. Considering previous dye and technique challenges, I redesigned the third garment to accommodate these findings. Like the *Disturbed* gown, this garment was also constructed with silk organza and cotton sateen. The Type VI technique was applied to this garment to include the embroidery and pole-wrapping techniques and two dye baths. First, fabric was dyed with woad and then embroidered and resisted for overdyed with madder (Table 5.3).

### ***Inspiration and Design***

In creating this garment, my challenge was to maintain cohesion with the *Rippled* and *Disturbed* designs through highlighting the overall theme as well as by harmonizing the selected color story. The goal was also to illustrate the climaxed water motion and communicate a conflicting and strong feeling through diverse design details. Various design options were sketched until an asymmetrical floor length dress, titled *Unsettled*, was finally created through reinterpreting the image of a large shower of water (Figure 5.16). The key mood to communicate through this design was the sense of an unsettled feeling. Thus, I created visual conflict through intermixing patterns of embroidery and pole-wrapping resist. At the same time, visual conflict appears in the asymmetrical style lines and the irregular shapes in the garment. As a result, this garment encompassed the design vision that illustrated the changes of water in motion and reflected the transformation in mood. Through repetition of color, all three designs successfully came together as a cohesive group of apparel art.

Figure 5.16 Rough sketches of Naturally Refined Series from reflective journal: Unsettled, Disturbed, Rippled.<sup>63</sup>



This third garment consisted of an hourglass silhouette with a dropped waistline and side seam closure. It was important that layering and gathering techniques were repeated in this garment to reflect the principle design elements featured in this collection. Cotton sateen was used to construct an embroidered strapless bodice, which was divided by a diagonal style line from dropped waist to opposite under bust. This seam allowed the insertion of three layers of folded silk organza fabrics to cascade over the left shoulder. The diagonal style line then was continued downward through the layering and gathering of silk organza around the right hip. To complete the hourglass silhouette, the garment incorporated a flared cotton sateen skirt layered with silk organza on top. The sheer fabric was able to occasionally expose the resist pattern created on the cotton sateen layer of the skirt, resulting in an unsettled feeling.

### ***Draping and Patternmaking***

Similar to the Disturbed design, new pattern pieces were developed through draping and patternmaking techniques to reflect the new design. Additional patterns were created on a mannequin and then were transferred onto paper patterns after which the fabric was cut finally according to a finalized paper pattern. Pieces to be embroidered were cut with a larger allowance for embroidery frame attachment. In addition, each piece was marked with construction guide and design details. To prevent confusion in handling and the dyeing process, each fabric piece was also coded according to the appropriate paper pattern.

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<sup>63</sup> From [Photograph by Lushan Sun]. (2012)

### **Technique Application: Embroidery**

To prepare for embroidery, a piece of precut and marked cotton sateen fabric was stretched onto the traditional frame. Then, the pattern was outlined in pencil, indicating light and dark colors. For this garment, single-variegated, parallel, random, seed, and spiral stitches were applied to enhance the smooth transitioning of colors and shapes in design (Figure 5.17). For instance, the parallel stitch was used in shaping small forms and filling tiny spaces, which was effective for shifting around curves when embroidering.

The embroidery design was divided across two pattern pieces. The larger piece, the waist yoke, was embroidered on the traditional frame, and the smaller piece, the bodice, was embroidered on a small embroidery hoop (Table 5.3). However, the hoop was not as convenient to handle as the frame because the fabric needed constant tension control to ensure consistent embroidery quality.

Moreover, all flosses, including iron and acid treated, were utilized to maximize the color range. Then, after the madder bath, the embroidery floss colors showed smooth transition of color value throughout the entire area in a vertical direction (Table 5.3). The outcome strongly contrasted in color with the background fabric, yet complemented the pattern on the fabric achieved through the pole-wrapping technique.

Figure 5.17 Naturally Refined Series: Unsettled embroidery detail.<sup>64</sup>






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<sup>64</sup> From [Photograph by Lushan Sun]. (2012)



Table 5.3 Technique application for Naturally Refined Series: Unsettled.

<b>Order of operation applied: Type VI—1. Dye fabric in woad; 2. Embroider fabric, resist fabric, overdye fabric in madder</b>	
Dye fabric in woad 	Embroider fabric 
Overdye fabric in madder with pole-wrapping resist 	

***Technique Application: Physical Resist and Dyeing***

The pole-wrapping physical resist technique was utilized again for this garment. Here, aluminum foil flexible duct was the main tool to resist the fabric. The embroidered and woad-dyed fabric pieces were wrapped tightly around the grooves of the foil duct and tightly secured with string (Table 5.3). The key to this technique was to strategically expose the embroidered area outside of the grooves for dyeing in madder bath. The outcome showed yellow and copper-red colored embroidery against tree bark-like striped patterned blue fabric. Although the result was visually attractive, flaws still remained with this technique. It was hard not to wrap over some parts of the embroidery due to its inherent circular curves and shapes (Table 5.3). Therefore, the technique was not as



effective and would be more appropriate to apply to an embroidery design with linear shapes that run in the same direction.

Similarly, the pole-wrapping technique was applied for resisting the cotton sateen skirt panels. To accommodate the large fabric size, a large aluminum duct with a shallow groove was utilized resulting in a hair-like striation pattern (Table 5.3). Additional ducts were prepared to increase the efficiency of the dyeing process. While one duct with resisted fabric was immersed in dye bath, the other was prepared to resist the next skirt panel. Through this continuous process, I was able to shorten the overall garment dyeing time.

When dyeing the silk organza fabrics, the light yellow color seen on the skirt, hip, and shoulder sections was achieved with a 30-minute iron bath without additional dye color. The first and second layer on the shoulder and hip portions of the garment were both dyed in a madder bath for one hour resulting in a light cinnamon color (Figure 5.18). Then, the outer layer was dipped in woad for 5 seconds to achieve the light brown color. In developing the colors for these two layers, I used the same formula for dyeing fabrics for *Disturbed* (Figure 5.15). However, the outcome showed variation. This may have been caused by the reduced concentration of the madder bath from previous dyeing. For this garment, the madder bath used was calculated at the same 50% WOF but may have been exhausted or weakened at the time of dyeing these two silk organza layers. Although lighter colors were created in the silk organza fabrics, they complimented well the rest of the colors attained in this garment.

Figure 5.18 Naturally Refined Series: Unsettled shoulder (left) and hip (right) detail.<sup>65</sup>



<sup>65</sup> From [Photograph by Lushan Sun]. (2012)

### **Technique Adjustment and Design Edit**

As the garment production progressed, challenges continued to emerge in both technique and design perspectives. To clarify, this garment took advantage of the natural light yellow color from the iron mordant when dyeing silk organza fabrics. The color was included among the ombré color combinations of the shoulder and hip cascading sections. However, due to the extended time the large pieces of silk organza spent immersed in the iron bath, the fabrics that were immersed first quickly drew most of the iron color from the bath, leaving the later immersed fabrics a much lighter shade of yellow. Thus, some fabrics had to be overdyed in another iron bath to increase the color saturation. During this process, I observed that iron was more immediately sensitive to temperature and dye in hot water (80 °C) than in cooler water temperatures.

Additionally, certain perspectives of design editing were also challenging. For instance, the skirt portion, consisting of a layer of yellow-beige silk organza over an underlayer of pole-wrapped resisted blue-red cotton sateen, showed a hair-like striation pattern on the cotton sateen while this pattern was only visible on the organza close-up. Thus, large negative spaces were seen in the skirt portion from a distance and offset the harmony of the overall garment appearance. After mentor critique, the decision was made to open the seams on the silk organza layer to partially expose the hair-like striation underneath. As a result, the final garment was able to balance the complex bodice with broken down negative space in the skirt through the openings in the top layer of the skirt (Figure 5.19).

### **Construction**

In constructing this third garment, the challenge was to create a stable inner structure to support the bodice. Consequently, a half-inch plastic waistband insert was sewn to the horizontal seams of the bodice and side seams. To reduce the weight of the skirt, only the bodice was lined with silk habotai, and an invisible zipper was sewn to the left side seam to provide garment closure. Further, the challenge of finishing the silk organza edges also returned when constructing this garment. Again, as for the *Disturbed* design, straight stitching topped with small overcast stitching was applied to all organza skirt hems.

Figure 5.19 Naturally Refined Series: Unsettled, front (left) and back (right).<sup>66</sup>



#### Naturally Refined Series: Unsettled

- Fabric: cotton sateen, silk organza, silk habotai (lining)
- Embroidery floss: silk, wool, cotton
- Embroidery stitch: single-variegated, parallel, random, seed, spiral
- Premordant: 12% aluminum sulfate (protein fiber), 5% aluminum acetate (cellulose fiber), 5% acid (silk organza)
- Natural dye: 50% madder, woad
- Order of operation: Type VI—1. Dye fabric in woad  
2. Embroider fabric, resist fabric, overdye fabric in madder

<sup>66</sup> From [Photograph by Lushan Sun]. (2012)

## Reflection

The overall appearance of each garment design well supported the intended water theme by repeating and reinterpreting color and pattern. Progressive rhythm and mood communicated by three different forms of water supported the inspiration for the collection. From *Rippled* to *Disturbed* to *Unsettled*, each garment can stand alone as a piece of unique fiber art and also group to reflect different levels of emotion and movement.

Throughout the stage of artifact development, many challenges emerged and were resolved by adjusting techniques and editing designs. In short, a progressive design flow was adopted in response to the nonlinear and unexpected events in this stage. Mentor critique was vital in my decision-making and redesign of the garments so that the initial goal of representing the three developed techniques in each garment was successfully accomplished in this collection. Also, Chinese embroidery, Su Xiu, and traditional physical resist dyeing techniques were reinterpreted in the final collection with the use of woad and madder dye. Although not all aspects of the initial design ideas resulted as expected, the fruition of the challenge and resolution eventually guided the collection to achieve the intended vision.

## **Chapter 6 - Exposition**

In this practice-based research, a collection of apparel art forms were created and showcased in an exhibit at the Kansas State University Student Union Kemper Gallery, March 5—24, 2012. This particular research requires the outcome to be considered differently than for traditional artwork (Gray & Malins, 2004). The purpose of choosing exposition over exhibit was that exposition offers information beyond the simple visual display of the outcome. I included the design process and informative background information for the public. As a result, this exposition was educational in providing the opportunity for the public to gain first-hand evidence of my research through presentation of not only the final designs but of the process as well (Gray & Malins, 2004). Meanwhile, it served in promoting public recognition and developing public knowledge of the Chinese traditional arts. Consequently, this exposition may generate inspiration and provide design possibilities to inspire textile and apparel designers and researchers through my research findings and displayed artifacts.

### **Theme Refinement**

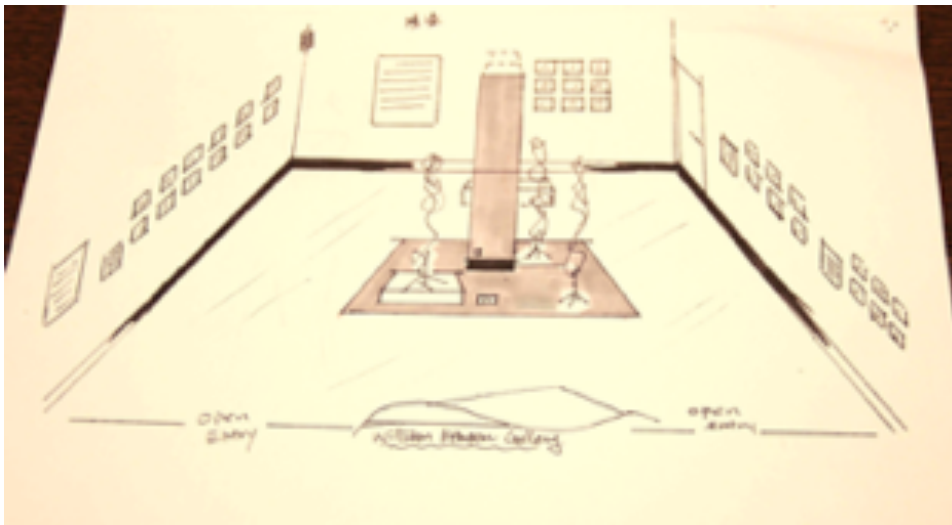
As previously mentioned, a written part of the Chinese character for the word dyeing (染) depicts water. Thus, this exposition revolved around the overall theme of water, and several specific elements support and enhance the impact. Primarily, the garments were designed to illustrate progressively increased speed and movement in water. To support this theme, the photographs of the garment dyeing and embroidery process and background information explaining the purpose and concept of the subject were displayed in the exhibit space. Such documentation is not seen in a classic exhibition context but is appropriate in a research exposition to reveal the applied methods (Gray & Malins, 2004). Further, the sound of water was played as background sound to strengthen the theme of this exposition.

### **Exposition Installation**

Overall, the exposition atmosphere was created through a streamlined arrangement of the displayed objects. The gallery was a rectangular space with two front entrances and a central pillar. The overall arrangement had the three garments

surrounding the pillar, the title and introduction on the wall opposite the entry and the design process (in images and text) on the side walls. To bring attention to the garments, I encircled the pillar with 1/8" hardboard creating a 12 x 12 foot island (Figure 6.1). To contrast with the dark floor and white wall in the space, the island was painted light gray. Each garment was placed on a raised rectangular platform and positioned at a different angle facing away from the pillar to allow multiple angles of viewing. The raised platforms not only helped to bring attention to the garments, the various heights of the platforms supported the theme of water to indicate water movement (Figure 6.2).

Figure 6.1 Tentative floor plan sketch.<sup>67</sup>



<sup>67</sup> From [Photograph by Lushan Sun]. (2012)

Figure 6.2 Exhibit installed.<sup>68</sup>



Content of the center back wall included the exhibit title in vinyl lettering, introductory and artist information to present the purpose and concept behind the artifacts (Figure 6.3 and Appendix D). To clarify the unique techniques applied in this research for the viewer, I provided background information for each natural dye used, embroidery stitch explored, and physical resist dyeing technique applied (Figure 6.3 and Appendix D). To enhance the viewer's knowledge and understanding of traditional Chinese embroidery, a piece of unfinished traditional Su Xiu was stretched on a traditional embroidery frame and displayed on the center back wall as well. This piece also allowed the viewer to compare and contrast traditional and modern techniques. Moreover, a grid of framed samples presented to the viewer select examples of natural dye color, embroidery stitches, and physical resist techniques explored (Figure 6.3).

On the two sidewalls, photographs revealed the embroidery and dyeing process of each garment in order from left to right (Figure 6.4). Photographs were grouped in two and mounted on a foam board to illustrate one complete step of the process with written

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<sup>68</sup> From [Photograph by Lushan Sun]. (2012)

labels for explanation. The label for each garment embroidery and dyeing process also provided the estimated time spent in production. As a result, the viewer was able to envision the complex process and further appreciate the effort and value of this research.

Figure 6.3 Introduction, title, technique background, traditional Chinese embroidery frame with Su Xiu, and exploratory samples are displayed on center back wall.<sup>69</sup>



Figure 6.4 Photographs of each garment embroidery and dyeing process displayed on left and right sidewalls.<sup>70</sup>



<sup>69</sup> From [Photograph by Lushan Sun]. (2012)

<sup>70</sup> From [Photograph by Lushan Sun]. (2012)



Upon entering the space, ideally the viewer would first focus on the garments on the center island and then turn to the center back wall where the title of the exhibit was mounted in vinyl lettering. The viewer would be guided through the space by the photographs on the sidewalls. Furthermore, track lighting on the ceiling was adjusted to better reveal the displayed objects.

### **Advertisement**

Visual imagery is important in attracting the public's attention to visit the venue. This exposition was advertised through event announcement posting on both the university campus and in the city (Appendix D). On campus, K-State Today and the College of Human Ecology News both advertised the event. The announcement flyer was also posted around the city in stores related to apparel and textile industry, such as Jo-Anne Fabrics & Crafts. I designed the announcement in portrait layout and printed it in two sizes. The design featured a detailed image of the embroidery to indicate the subject of the exposition. A semi-transparent image of a ring of water was strategically placed on the announcement to indicate the overall theme. Title and artist name were placed on the top section, time and location were listed midway in the layout, and sponsors and contact information were put on the bottom. This composition was intended to lead the eye from top to bottom.

### **Juried Review**

In addition to the university exhibit, I will submit the designs for juried review. External review provides an outside measure of the originality, quality and value of the works. The three garments developed through this practice-based research will be submitted to the juried 2012 Design Exhibition of International Textile and Apparel Association (Appendix H).

## **Chapter 7 - Discussion**

This project comprised five stages that led to this final discussion. During the goal identification and ideation stages, traditional Chinese Su Xiu and dyeing techniques were researched and moderately explored to refine objectives and timeline for the project. In the design exploration stage, the flosses and fabrics were sampled with different stitches, physical resist, and dyeing procedures following critique. When analysis was drawn, new embroidery and dyeing techniques were developed based on the slow design concept. When developing artifacts, designs were established and produced through draping and patternmaking, technique application, technique adjustment, design edit, and construction. In exposition stage, the overall gallery theme was refined, the installation was planned, and advertisement was developed through event announcement distribution. This chapter discusses the main findings as well as the limitations and recommendations generated for each research variable and the exposition.

### **Findings**

Under the slow design framework, the principles of inheriting tradition and maintaining eco-efficiency guided this project. The unique techniques developed in this project inherited traditional characteristics of Chinese Su Xiu, physical resist techniques (Zha Jiao, Feng Jiao, pole-wrapping, and Jia Xie), and natural dyeing (woad and madder). The outcome was evident that these techniques successfully simplified traditional procedure and reduced production time, energy, and dyeing material while encompassing elements of traditional art using a modern aesthetic.

Inheriting tradition was achieved in several ways. First, I took advantage of the dye saturation of silk, cotton, and wool floss with aid of iron and acid pretreatment to attain value transition in embroidery floss color seen in traditional Su Xiu techniques. Demonstrating a modern interpretation of Su Xiu, I created original water inspiration patterns by applying seven different Su Xiu stitches. The embroidery outcome clearly showed four of the eight characteristics of Su Xiu, as summarized by Feng Zhu (1987):

- Smoothness: flat and even embroidery surface
- Shine: clear and colorful appearance

- Neatness: even stitch ends and outline
- Balance: well-balanced thickness of stitches
- Harmony: well-planned color palette and value
- Transition: smoothly transitioned curves and corners and color value
- Fineness: detailed stitching
- Compactness: tightly packed stitching

Smoothness, neatness, transition, and compactness of the embroidery surface were achieved through the combined use of 2-ply 100% wool, 16-ply 100% silk, and 1-ply 100% cotton floss. Conversely, embroidery shine was hard to obtain due to the natural fuzzy appearance of staple fiber in wool and cotton. Also, the harmony of the embroidery color palette and value were limited due to the use of only two natural dyes. In achieving balanced stitches, although 2-ply 100% wool floss was used as a whole to ensure compatibility with the cotton and silk flosses, the embroidery surface was not ideally balanced. Also, it is important to note that the same degree of embroidery fineness found in traditional Su Xiu is not necessary on apparel. To clarify, traditional Su Xiu was normally applied in fine stitches to create delicate decorative art, whereas the techniques developed in this study were intended for wearable apparel. Also, applying fineness of embroidery on apparel will increase production time and decrease wearing durability. Thus, such a characteristic of Su Xiu needed to be adapted to the purpose of the final apparel product.

A second way in which inheriting tradition was achieved was with resist patterns developed through the application of pole-wrapping and folding and clamping physical resist techniques to reinterpret traditional Jiao Xie and Jia Xie techniques. Lastly, the traditional use of natural woad and madder dye were utilized in the dyeing process and created a wide range of colors for selected fabrics and flosses.

Next, eco-efficiency was maintained through several perspectives in this project. First, the use of natural dye and naturally fibered fabric and floss supported the environmentally friendly intention. However, the most important achievement of this project was to eliminate the embroidery floss dyeing procedure through three developed techniques. Traditionally, the embroidery floss was dyed separately from the fabric to

achieve groups of different color shades and then was stitched onto prepared fabric. In this project, three alternative techniques were developed:

- Type I order of operation consisted of embroidering undyed floss onto undyed fabric and then dyeing the completed embroidery in one or two dye baths with or without physical resist techniques.
- Type III order of operation consisted of two baths, in which undyed fabric was first embroidered with undyed floss and dyed with madder then overdyed with woad.
- Type VI order of operation also consisted of two baths, in which fabric was initially dyed with woad followed by embroidery using undyed floss and then overdyed with madder applying a physical resist technique.

Compared to the traditional Su Xiu technique, the above techniques reduced the time and energy spent in dyeing individual color shades on floss and fabric. Consequently, using the developed techniques diminishes the time to strategically match color shades when embroidering. Thus, production time, energy, and dye supplies should be dramatically reduced. On the other hand, the developed techniques require one to be knowledgeable in embroidery, physical resists, and natural dye techniques to ensure a successful outcome.

Additional findings were also discovered in the dyeing procedure. Using the premordant treatment, I found that woad dye overpowered the effect of acid and iron additives and showed no distinct change in colors. The other important discovery was that madder was successful as an overdye. In the Type VI technique, it served as a second overdye bath to create a physical resist pattern. The madder overdye bath was also adopted to adjust or correct color result post woad overdye, thus reducing the risk of unexpected events commonly seen in practice-based research.

Moreover, using madder cake extract at 50% WOF and woad powder extract, I have found a wide range of possible colors. Instead of predictable bright red, madder cake extract provided rich copper-red and orange shades. When woad was used as an overdye with madder, shades of brown and gray-black were developed. Moreover, the madder cake exhaust bath generated shades of yellow. An exhaust bath refers to the dye

remaining after the initial fiber is dyed and removed, resulting in a less saturated color for each additional fiber added to the bath. Thus, green shades can also be achieved with woad overdye from the blue over the yellow shade. With only two natural dye colors, madder and woad, all three primary colors can be attained.

## **Limitations and Recommendations**

During the course of this practice-based research, some limitations remain with the variables, and they are discussed in the next section. The techniques developed in this project were through exploration using silk habotai, silk organza, silk gauze, and cotton sateen fabrics with silk, cotton, and wool flosses. The evaluation of the techniques relied on four criteria: floss to fabric color contrast, the range of color in floss, number of dye baths, and dyeing techniques applied. This next section discusses limitations of and recommendations for each technique applied. Finally, limitations and recommendations regarding the exposition are presented.

### ***Technique Application***

#### ***Fabric and Floss Usage with Su Xiu Stitches***

Although Chinese Su Xiu stitches were successfully reinterpreted into original patterns, a few limitations remain concerning the material used. Only one type of wool fiber (2-ply 100% wool) was tested in this project. For the future, stronger and thinner wool floss, such as acrylic blended wool floss, could be considered to improve balance and shine on the embroidery surface. Also, with the 6-ply 100% cotton, only 1-ply was explored for embroidering whereas many cotton plies could be tested in a combination of 16-ply silk and 2-ply wool fibers. Further, other natural fiber embroidery flosses known for their dye uptake, such as alpaca, could be considered with silk and cotton floss. In addition, only three types of floss were selected to develop the color value transition in Su Xiu with the aid of acid and iron premordant. For future study, additional types of embroidery floss and fiber content could be researched and considered to test dye color saturation to develop increased color value transition in embroidery without the use of these premordants. As a result, energy and time may be reduced.

In this research, the technique evaluation criteria depended on the contrast of floss against fabric in reaction to dye color. Considering the fabrics used were selected by specific weight, which affected the dye saturation (Appendix C), this variable was only directly related to the color outcome through dyeing time. Thus, various fabric weights and weave structures should be explored in future study.

### ***Physical Resist Dyeing Technique (Jiao Xie and Jia Xie)***

Physical resist dyeing techniques explored in this project to supplement the overall design elements included the following: traditional Zha Jiao (binding), Feng Jiao (stitching), pole-wrapping, and Jia Xie (folding and clamping). There are a variety of patterns that can be created in each technique category. However, only one pattern design was tested on fabric for each selected technique. Zha Jiao was tested with binding object on center of the fabric; Feng Jiao was applied through folding and stitching fabric to form layers of diamond shapes; pole-wrapping was experimented with wrapping and compressing fabric around a aluminum duct; and Jia Xie was simplified and reinvented through folding and clamping the fabric between flat wood blocks to form teeth-like pattern. For the future, additional physical resist pattern selection could be added to increase the design possibility while widening the scope of the study.

In addition, when used with Type VI technique with pole-wrapping, embroidery should be designed with a linear pattern that runs in one direction and parallel to ensure full exposure to dye when resisted. This technique should also allow longer dyeing time in a madder bath to allow deeper saturation of the red color.

### ***Natural Dye***

In this project, both woad and madder were selected for their traditional use and possible color range, and both were used as a first dye bath and overdye bath. Madder cake extract was calculated at 50% WOF in all dyeing processes. For future study, madder dyestuff could be tested at different percentages of WOF. Further, the madder extract was used in cake form, which resulted in copper toned red colors. This type of extract has produced much less intensified red colors than the powder extract I experimented with prior to this study. Thus, madder extract may be explored in powder form in the future for additional color choices. On the other hand, the woad utilized in

this project was not purchased from China and did not provide the traditional color shades. In future, the woad dye extract should be sourced from its origin, Zhejiang Province. Moreover, a live woad bath could be attempted throughout the entire process in a similar study to reduce the amount of time, energy and chemical. This would further support the concept of eco-efficiency.

### ***Mordant***

Several chemical additives were used as premordant agents to achieve various color intensity in natural dye. To increase the color range of all flosses, iron was used at 5% WOF to darken colors. However, iron pre-treatment resulted in less saturated colors instead of darkened colors; thus, the color in iron treated floss did not work ideally with the rest of the shades in achieving color value transition. To further explore the color range and embroidery color value transition, future researchers might test various percentages of WOF of mordant agents.

### ***Methodology***

In the process of this practice-based research, a qualitative approach was accomplished through use of tacit knowledge, self-reflection, committee member critique, and written and photographic documentation. Meanwhile, research process flow was created to reflect five stages in this project, although developing the final artifact required revising the linear design process flow into a progressive design flow to illustrate the approach that was ultimately used in this project. Further, in documenting the artifact development stage, specific lab details and comments were difficult to record on a timely base. Perhaps video recording could be considered to improve the reliability of documentation. On the other hand, communication was vital in supporting the progress of the design process. By verbally sharing my thought processes and ideas, I shortened the decision-making time to deal with unexpected events in the design exploration and artifact development stages.

### ***Exposition***

When reviewing the exposition, I found that the written statements (introduction, artist statement, design process) and photographs were effective in communicating the

research purpose, process, and outcome in an attractive and logical manner. The challenge was to select the appropriate amount of information to share with the less knowledgeable public. Although not all aspects of the research were presented to the public, the key components of the techniques developed were well illustrated. For the future, the photographs of the embroidery and dyeing process for each garment could be presented with a directional arrow symbol to indicate the order of operation to better guide the viewer. Also, similar expositions could consider hanging garment or textile pieces from the ceiling exposing various angles and providing an alternative atmosphere for the viewer.

### **Reflection**

Overall, this project has provided me with rich information that strengthened my tacit knowledge of slow design, embroidery, physical resist dyeing, and natural dye. It also has assisted me in understanding the process of practice-based research in design, during which challenges emerged and were overcome. By documenting the process through writing and photography, I have gained valuable insights to improve the documenting methods for future practice-based study.

The outcomes of this research fulfilled my initial objectives and intentions in a satisfying way. The techniques developed not only reduced time and energy in maintaining eco-efficiency but also illustrated inherited elements of traditional Chinese textile art. Further, this study has provided me with alternative options for surface design. The possible options that I can explore after this research are endless. My findings and final outcome have also further solidified my confidence in the advancement of traditional Chinese Su Xiu and various dyeing techniques on apparel. Although the goal of illustrating inherited tradition still needs greater effort in research and development, the findings and outcome of this design research have contributed to the knowledge of passing along Chinese Su Xiu and traditional dyeing techniques with eco-efficient approaches that are appropriate in a modern context.



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## Appendix A – Tentative Timeline

<b>Date</b>	<b>Activity</b>
12/1/2010	Proposal outline due
3/10/2011	Proposal outline revised
3/23/2011	Proposal draft (contextual review) due
4/7/2011	Proposal second draft due
4/24/2011	Proposal third draft due
5/4/2011	Proposal fourth draft due
5/9/2011	Proposal fifth draft due
5/10/2011	Begin design inspiration for collection
Summer '11	Begin initial samples to determine appropriateness of embroidery, soy resist and dye methods. Research and sketch garment ideas.
8/22/2011	Fall 2011 term begins
8/30/2011	<b>Proposal Presentation with committee members</b>
9/2011	Experimentation and critique samples
10/15/2011	Develop exhibit collection and theme and committee critique; report writing
10/2011	Develop/construct exhibit collection and committee critique; report writing
10/31/2011	Progress meet with committee
11/2011	Develop/construct exhibit collection and committee critique; report writing
11/21-11/27/2011	Thanksgiving holiday
12/2/2011	Progress meeting with committee
12/2011	Develop/construct exhibit collection; report writing
12/25/2011	Christmas holiday
12/30/2011	New Years
1/2012	Develop/construct exhibit collection; report writing
2/2011	Finalize exhibit collection; report writing
2/20/2012	Advertise exhibition to public
3/1/2012	<b>Complete iSIS Graduation Application</b>
3/2012	Finalize report
3/2/2012	Exhibition installation at K-State Student Union Gallery
3/5/2012	<b>Exhibition opens</b>
3/7/2012	<b>Exhibition opening reception 4-7pm</b>
3/24/2012	Exhibit ends
3/25/2012	<b>De-installation</b>
4/3/2012	<b>Submit report to committee; approval to schedule final examination for name to appear in commencement program</b>
4/25/2012	<b>Oral defense given to committee members, 9:00am</b>
4/27/2012	<b>Final ETDR submission to KREx; commencement registration; exit survey</b>
5/4/2012	Last day of school
5/11/2012	Graduate school commencement (Bramlage Coliseum at 1:00pm)

## Appendix B –Fabric and Floss Detail

<b>Material</b>	<b>Fiber content</b>	<b>Detail</b>	<b>Structure</b>	<b>Source</b>
<b>Hand Embroidery Floss</b>				
Cotton	100% Cotton	DMC pearl cotton, 5m, white	S-twist, 2-ply	Hersherner's
Cotton	100% Cotton	DMC pearl cotton, 25m, white	S-twist, 6-ply	Joann's
Silk	100% Silk	440m, white	Z-twist, 16-ply	Taobao.com
Wool	100% Wool	25m, ivory	S-twist, 2-ply	Renaissance Dyeing
<b>Fabric</b>				
Cotton sateen	100% Cotton	45", undyed	Woven	Dharma Trading
Silk habotai	100% Silk	16mm 45", undyed	Woven	Dharma Trading
Silk gauze	100% Silk	4.5mm 45", undyed	Woven	Dharma Trading
Silk organza	100% Silk	5mm 55", undyed	Woven	Dharma Trading

## Appendix C – Budget

<i>Price before tax and shipping; proposed to Agriculture Experiment Station</i>						
<b>Supply Type</b>	<b>Item</b>	<b>Detail</b>	<b>Source</b>	<b>Price</b>	<b>Quantity</b>	<b>Total</b>
Chemical aid	Alum (Potassium aluminum sulfate)	1lb.	Dharma Trading	\$3.49	1	\$3.49
	Aluminum acetate	1lb	Hill Creek Fiber Studio	\$31.50	1	\$31.50
	Cream of tartar	4oz.	Hill Creek Fiber Studio	\$5.75	1	\$5.75
	Citric Acid Powder	1lb.	Dharma Trading	\$4.25	1	\$4.25
	Iron (Ferrous sulfate)	1lb.	Hill Creek Fiber Studio	\$5.75	1	\$5.75
	Lye	160z.	Hill Creek Fiber Studio	\$12.45	1	\$12.45
	Orvus paste	1lb.	Hill Creek Fiber Studio	\$6.00	1	\$6.00
	Soda ash	1lb.	Hill Creek Fiber Studio	\$4.60	1	\$4.60
	Textile Detergent	32oz.	Dharma Trading	\$6.50	1	\$6.50
	Thiourea dioxide	8oz.	Hill Creek Fiber Studio	\$8.90	1	\$8.90
	Vinegar	1gallon	Wal-Mart	\$2.00	3	\$6.00
<b>Total chemical aid</b>						<b>\$95.19</b>
Tool	Ph test paper	n/a	Dharma Trading	\$9.75	1	\$9.75
Dye extract	Woad	25g	Hill Creek Fiber Studio	\$16.10	4	\$64.4
	Madder	25g	Hill Creek Fiber Studio	\$11.71	5	\$86.55
	Turmeric	1lb	Nuts Online	\$6.49	1	\$6.49
<b>Total dye extract</b>						<b>\$157.44</b>
Embroidery thread	Cotton	DMC pearl cotton, 5m, white	Herrschners	\$1.67	10	\$16.70
	Cotton	DMC	Joann's	\$1.56	2	\$3.12



		pearl cotton, 25m, white				
	Silk	440m	Taobao.com	\$2.00	10	\$20.00
	Wool	250m, white	Renaissance Dyeing	\$13.03	5	\$13.03
<b>Embroidery thread total</b>						<b>\$48.15</b>
Fabric	Cotton sateen	45"	Dharma Trading	\$8.15	10	\$81.50
	Silk habotai	16mm 45"	Dharma Trading	\$7.09	10	\$79.90
	Silk gauze	4.5mm 45"	Dharma Trading	\$3.10	11	\$34.1
	Silk organza	5mm 55"	Dharma Trading	\$5.06	11	\$55.66
<b>Total fabric</b>						<b>\$249.25</b>
Notion	Interfacing	Pellon sheer fusible 20"	Joann	\$2.00	4	\$8.00
	Invisible zipper	Coats & Clark 22"	Joann	\$3.29	8	\$26.32
<b>Total notion</b>						<b>\$34.32</b>

## Appendix D – Exposition

Title: Naturally Refined 染: Sustainable Fiber Art Exhibit

Time: March 5—24, 2012

Location: William T. Kemper Art Gallery – Kansas State University, Manhattan, KS

### Event Announcement

**NATURALLY REFINED** 源

Sustainable Fiber Art Exhibit

**OPENING** | Wednesday, March 7, 4-7pm  
William T. Kemper Art Gallery  
First floor, K-State Student Union,  
Manhattan, KS  
Free Admission

**RECEPTION** |

*Exhibit dates: March 5-24, 2012  
Monday-Friday, 8am-5pm*

M.S. Design Research Presented by  
**Lushan Sarina Sun**

Sponsored by  
COHD Scholarship  
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Kansas Agriculture Experiment Station  
Department of Apparel, Textiles & Interior Design  
College of Human Ecology, Kansas State University

Advised by Dr. Sherry Haar  
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## Introduction

As our world becomes more polluted, sustainable approaches in various aspects of society are gaining popularity and attention. **Slow design** is proposed after the slow food movement to promote slowing down production processes and increasing product quality and keepsake value. The concept suggests a slower way of living and rekindling the relationship between the old and the new. It also counteracts the fast-pasted system of the fashion industry. Ever since western industrialization, fashion is more accessible due to mass markets, which produce fast and disposable products. Meanwhile, toxic synthetic dyes, popularized in the 1950s, quickly replaced the use of natural dyes in textile industry. Thus, our environment began to deteriorate due to increased stress resulting in irreversible consequences of pollution. Due to the current practices of economic globalization, modern day people are placing less importance on their cultural traditions and arts. Thus, our society is advancing forward at the expense of losing valuable cultural traditions and arts.

China has been known for its ancient civilization and rich culture; however, many of its arts and crafts are facing decline and extinction today due to lack of proper conservation and advancement. My interests lie in the application of Chinese art in surface design. Born in the textile city, Nantong, China, I'm fascinated with the diverse range of local textile arts, such as Chinese embroidery. As I became acculturated to the U.S. after immigrating at the age of 12, my design aesthetic became infused with both eastern and western influences, which usually translates into traditional and modern elements in my design. While learning the concept of slow design in graduate school, I felt the urge to celebrate and sustain the spiritual and material civilization of the Chinese culture by creating a modern artistic interpretation of Chinese embroidery using an environmentally conscious approach that is applicable to apparel.

Through my M.S. design research, I have developed **embroidery-dyeing techniques (绣染)** that combined traditional Chinese art of embroidery, **Su Xiu (苏绣)**, and **physical resist dyeing techniques (绞缬, 夹缬)** with **natural dyes (woad and madder)**. Traditionally, Chinese embroidery arts achieve color values through use of different shades of pre-dyed silk floss. My embroidery design generates color value transition by taking advantage of the different dye saturation levels on various fiber content, such as silk, cotton, and wool floss. Essentially, both the embroidery and background fabric are dyed at the same time, ultimately eliminating the procedure of dyeing individual shades of floss and thus reducing production time. These new techniques have infused traditional surface design techniques into the reinterpreted modern design, aiming to obtain increased visual interest and dimension.

Chinese film director, Zhang Yimou, once said that creation is the process in which body and soul reaches its limitation. The apparel group in this exhibit is a result of hours of background research, photographic and written documentation, and periodic peer critique as well as constant self-doubt. My inspirations are from the rich colors obtained from dyeing and from the significance of water. Water serves as the most critical medium in the dyeing process. It is evident in the Chinese word for dyeing, *ran* (染), which is written with three parts: water; number nine, indicating the many procedure in dyeing; and wood, indicating natural dye. The versatility of water also inspired me to create garments that reflect the motion and rhythm of water and express the emotion I experienced during the designing process. Although the creative process was often frustrating due to unplanned results, the intuitive nature of the research yielded pleasant surprises and outcomes that are truly naturally refined.

Lushan Sarina Sun, 2012

## Traditional Technique Background and Identification

### Chinese Embroidery—Su Xiu (苏绣)

Embroidery is one of the most ancient national crafts in China. The earliest Chinese embroidery dates back thousands of years and has been refined through various advancements and diversifications in its technique. Su Xiu (pronounced as *sue shio*), centralized in Suzhou, Jiangsu Province, has established its reputation as the finest and leading embroidery among the major Chinese embroidery categories. In this design research, the techniques of Su Xiu (苏绣) as well as its unique subcategories, such as Shen Xiu (沈绣) and Luan Zhen Xiu (乱针绣) or random stitch embroidery, are considered to broaden the range of design possibilities.

The Su Xiu (苏绣) stitches explored in this research include:

- Single-variegated stitch (单套针)
- Raised stitch (肉入针)
- Parallel stitch (齐针)
- Seed stitch (打子针)
- Spiral stitch (旋针)
- Scale stitch (刻鳞针)
- Random stitch (乱针)

### Natural dye—woad & madder (菘蓝, 茜草)

The application of natural dye in China can be traced back to the Stone Age. There are two natural dyes used in this design research. Woad (*Isatis indigotica*), or *song lan* (菘蓝) and *ban lan gen* (板蓝根) in Chinese, is also commonly known as Chinese woad. It is cultivated mostly in eastern parts of China, mostly in Jiangsu Province, and it is used as herbal medicine and one of the major sources of the blue dye group, indigoid. Woad is a vat dye that needs no mordant, a chemical substance that enhances the color properties. Vat dye, one of the oldest known dye techniques, refers to the container that ferments indigo leaves. The blue color is the result of the oxidization process. Before woad is dissolved and exposed to air, it appears green-yellow in color. In China, woad is said to produce seven shades of blue, from the whitest blue to the blackest blue. Woad, like many other indigo species, is commonly used as a base dye color with other dyes applied as overdyer to achieve a various shades of color.

Madder (*Rubia cordifolia* L.), or *xi cao* (茜草) in Chinese, is known as one of mankind's most ancient red color dye sources and also serves as a Chinese herbal medicine. It is a natural dye that requires a pre-mordant in its dyeing process to enhance the coloration and colorfastness. Madder, containing alizarin as its main color content, is only soluble in alcohol and alkaline liquids.

## Physical resist technique (绞缬, 夹缬)

Physical resist techniques, commonly known as tie-dye, are applied to achieve surface patterns through fabric manipulations binding, stitching, clamping, and wrapping. Resisted fabric can be dyed in an immersion bath or hand painted directly onto the surface. About two thousand years ago, China had already obtained several physical resist dyeing techniques that have been passed down in Chinese history in various regions influenced by subcultures. Jiao Xie (绞缬), Jia Xie (夹缬), and pole-wrapping, or commonly known as *shibori* in Japanese, were the representative ancient dyeing techniques in China. Yunnan, Guizhou, and Jiangsu Provinces are the major locations that produce these techniques.

The four main categories of physical resist techniques explored in this research are:

- Zha Jiao (扎绞, binding)—a portion of fabric is tightly wrapped with thread to enclose an object in order to form square or circular shapes after dyeing.
- Feng Jiao (缝绞, stitching)—fabric is stitched through single or multiple layers in desired pattern, then the thread is drawn tightly to secure the resist.
- Jia Xie (夹缬, fold and clamping)—fabric is folded or pleated in two or more directions into neatly shaped bundles and tightly clamped between boards to secure resist.
- Pole-wrapping—fabric is wrapped around a pole, compressing it into folds, and tightly secured with string.

## Appendix E – Premordanting Formula for Cellulose Fibers

Wipplinger, Michele (2005). Natural dye instruction booklet. [www.earthues.com](http://www.earthues.com)  
Summarized by Sherry Haar (2010).

### Auxiliaries:

Liquid Scour	5.5% WOF
Soda Ash	2% WOF
Aluminum Acetate	5% WOF

### Fabric Scour – First Bath:

1. Weigh fabric and record weight in grams.
2. Add enough hot water to kettle to allow fabric to move freely (don't add fabric yet).
3. Add liquid scour at 5.5% WOF to water in kettle and stir.
4. Dissolve soda ash (2% WOF) by adding boiling water to beaker with soda ash; once dissolved add to kettle of water with liquid scour.
5. Heat bath to 82°C(180°F) over 20 minutes; hold for 30 minutes; rotate fabrics regularly.
6. Rinse the fabric quickly in warm water, gently extract and proceed to the second bath.

### Mordant Fabric – Second Bath:

1. Calculate aluminum acetate amount (5% WOF) and dissolve by adding boiling water to beaker and stir.
2. Fill large pot with hot water (make sure rusty water is gone) and add the dissolved aluminum acetate, stir.
3. Add the damp, scoured fabric.
4. Hold at 38°C(100°F) for one hour; rotate fabrics regularly; cool overnight.
5. Next day (or Monday), rinse the fabric quickly in warm water. Store wet fabric in plastic sealed bag. Label with fabric name (fiber and weave), weight, mordant date.

## Appendix F – Premordanting Formula for Protein Fibers

Wipplinger, Michele (2005). Natural dye instruction booklet. [www.earthues.com](http://www.earthues.com)  
Summarized by Sherry Haar (2010).

### Auxiliaries:

Synthrapol or mild shampoo or soap (no detergents)

Potassium Aluminum Sulfate           12% WOF

Cream of Tartar                         6% WOF

### Fabric Soak:

1. Weigh fabric and record weight in grams.
2. For SILK: Set washing machine to hot, add 1.25 ml textile detergent/gal. water and set at soak for 30 minutes, rinse and spin cycle.
3. For WOOL: Dissolve 2.5 g orvus paste/gal. warm tap water (40°C). Soak wool for 10 minutes. Rinse in warm tap water.

### Mordant Fabric:

1. Calculate aluminum sulfate amount (12% WOF) and cream of tartar (6% WOF). Place each in a beaker. Dissolve each by adding boiling water to each beaker and stir.
2. Fill large pot with warm water (make sure rusty water is gone) and add the dissolved alum and cream of tartar.
3. Add the damp fabric.
4. Bring the water temperature up to 85°C (185°F) over 45 minutes.
5. Rotate fabrics regularly.
6. Hold temperature for one hour; cool overnight.
7. Next day, rinse the fabric quickly in warm water. Store wet fabric in plastic sealed bag. Label with fabric name (fiber and weave), weight, and mordant date.

## Appendix G- Indigo Vat Dyeing with Extract

Natural Dye Instruction Booklet, Michele Wipplinger (2005) & Workshop Booklet (2008)

Summarized by Sherry Haar (2010).

### Making the Extract Stock

1. Put 25g of natural ground indigo into a quart glass jar with a wide mouth.
2. Add 25 ml (¼ cup) warm water (27°C/80°F; room temperature) and stir to make paste.
3. Add approx. 274 ml (2 cup) more water and stir. The solution should be opaque and blue.
4. Add 13g of sodium hydroxide or lye\* to 25ml of water to dissolve the indigo. If powdered, dissolve first.
5. Dissolve 13g thiourea dioxide\**into* 100ml (1 cup) nearly boiling water. *Must add to water or it could explode.* Pour into stock solution.
6. Let this stock solution rest for 15 minutes to dissolve and reduce. It will change from dark blue to greenish-yellow with a coppery scum on the surface.
7. To check if stock solution is ready, dribble some solution down a white plastic surface and note the change from a transparent green-yellow to a dark opaque blue once oxidized. The pH should be between 10-11. \* **Must wear mask and goggles.**

### Dye Baths

Prepare two baths, one for protein and one for cellulose.

1. Fill dye pots with water
  - a. Silk and Wool: 49°-55°C (120°-130°F) Hot water
  - b. Cotton and Rayon: 32°-38°C (90°-100°F) Warm water
2. Add 237ml (1 cup) dye stock; stir.
3. Note color
  - a. Clear green-yellow, ready to dye.
  - b. If it changes back to opaque blue, there is too much oxygen; add 2.5-5 ml (.5-1 tsp) thiourea dioxide dissolved in water.
  - c. If it clear yellow, there is too much thiourea dioxide; paddle the bath to reintroduce some air until it turns green-yellow.
4. Check pH
  - a. Silk and wool alkaline pH 10.5-10.8
  - b. Cotton and rayon pH 11
  - c. To **increase pH**: Add dissolved soda ash (sodium carbonate). Make solution of 59g (4tbl) soda ash in 1liter boiling water. Pour 59ml-237ml (1/4 – 1 cup) of this solution into indigo bath as needed to raise pH.
  - d. To **decrease pH**: Add lemon juice or citric acid solution in small amounts to decrease pH. We'll figure out amounts as none were provided.
5. Natural hide glue, 5g (1 tsp) dissolved, can be added to protect wool from alkali and maintain sheen of the silk.



### **Fabric into Dye Bath**

1. Gently submerge wetted out fabric into bath for *no more than 1 minute for first dip*.
2. Gently remove and Do Not let fabric drip into bath; rather, place on tray.
3. Let sit for 20-30 minutes.
4. For darker shades the fabric can be dipped again following the above procedures, but for a longer dip of 2-5 minutes. If the fabric does not get darker, more indigo stock needs to be added to the bath or the first dip was too long.
5. If the fabric is splotchy or grainy, place in water to oxidize.

### **Dry Out or Oxidize Fabrics**

Whenever possible allow fabrics to dry or oxidize for at least 24 hours prior to finishing steps below. Once dry, remove resists prior to finishing.

### **Finishing**

#### **Neutralize**

1. Wool and Silk: Rinse and then soak in vinegar/water (59ml vinegar per pound fabric) for 15 minutes.
2. Cotton and Rayon: Rinse and then soak in tannic acid/water (tannic acid chemical or 5 tea bags per pound fabric) for 15 minutes.
3. Soak until pH is between 6-7.

#### **Wash**

1. By Hand or Machine: Wash in hot (75°-85°C; 170°-185°F) water with neutral soap (orvus paste or shampoo textile detergent) for 20-45 minutes to remove excess indigo. Rinse with warm water until the color runs clear.
2. Dry until damp; Iron dry to avoid permanent creases.

## Appendix H- Juried Review

### Abstracts--ITAA 2012 Fiber Art Mounted Exhibit Graduate Level

**Abstract**

**Category:** HILG HIME FALG **FAME** TMLG TMME  
**Level:** Professional **Graduate** Undergraduate  
**Title:** Naturally Refined Series: Rippled

**Purpose:** Traditional Chinese Su Xiu embroidery is applied using pre-dyed silk floss on silk fabric producing mainly decorative home furnishings. The purpose of this design was to explore the application of Chinese Su Xiu embroidery stitches with un-dyed cotton, silk, and wool embroidery floss onto silk and cotton fabrics for use in apparel design. Thus utilizing the different fiber reactions to the natural dyes madder and woad to create color value transition. With the aid of pretreatments, each embroidery floss fiber created three different shades of color after dyeing. Also, the Chinese physical resist technique of pole-wrapping was reinterpreted to add visual interest to the design. The embroidery patterns and garment silhouette was inspired by a form of water drop.

**Process:** Following pattern development, fabrics were premerdanted in an iron bath. Side front panels were embroidered with cotton, silk, and wool floss and dyed with madder. Skirt panels were pole-wrapped and dyed with madder to achieve a ripple-like pattern in color and texture. The center front panel was dipped in madder bath at both ends to achieve an ombre effect. The shoulder yokes and sash were dyed in madder then overdyed in woad to achieve a dark shade of blue, with the sash dyed in an ombre effect.

**Techniques:** Chinese Su Xiu embroidery stitches: parallel, single-variegated, raised, and random stitches. Madder immersion dye. Ombre effect. Woad overdyed. Physical resist of pole-wrapping. Draping and machine construction.

**Materials:** Embroidery Floss: 100% silk, 100% wool, 100% cotton. Garment: 100% silk organza 5mm, 100% silk habotai 16mm. Lining: 100% silk habotai 16mm.

**Date Completed:** 2012  
**Measurements:** Bust-33" Waist-25" Hip-35"



**Abstract**

**Category:** HILG HIME FALG **FAME** TMLG TMME  
**Level:** Professional **Graduate** Undergraduate  
**Title:** Naturally Refined Series: Disturbed

**Purpose:** Traditional Chinese arts of Su Xiu embroidery and Jia Xie folding and clamping techniques were reinterpreted with modern techniques for apparel design. In place of using undyed silk floss; cotton, wool and silk skeins were pretreated and dyed with madder and woad utilizing the fiber's reaction to dye to achieve a range of color. The embroidery patterns, fold and clamp resist pattern and garment silhouette were inspired by the splash of water.

**Process:** Following pattern development, cotton sateen and silk organza (waist yoke and bodice) were embroidered using premerdanted cotton, silk, and wool floss. The silk organza for the outer skirt layer and outer fold of bodice were folded and clamped between flat wooden boards to create teeth-like pattern. Fabrics were then dyed with madder, then overdyed in woad for varying amounts of time to achieve a range of colors from orange to gray. The cotton sateen under skirt was immersed in a madder exhaust bath to achieve a light shade of red.

**Techniques:** Chinese Su Xiu embroidery stitches: parallel, single-variegated, raised, spiral, and random stitches. Madder dyed fabric in immersion dye. Woad overdyed fabric. Physical resist of folding and clamping. Draping and machine construction.

**Materials:** Embroidery: 100% silk floss, 100% wool floss, 100% cotton floss. Garment: 100% silk organza 5mm, 100% cotton sateen. Lining: 100% silk habotai 16mm.

**Date Completed:** 2012  
**Measurements:** Bust-32" Waist-25" Hip-35"



## 2012 Proceedings

Honolulu, Hawaii



Naturally Refined Series: Rippled

Lushan Sun, Designer  
Sherry Haar, Faculty Mentor  
Kansas State University, USA

Keywords: Slow design, sustainability, embroidery, natural dye, resist

As our world becomes more polluted, sustainable approaches in various aspects of society are gaining popularity and attention. Slow design is proposed after the slow food movement to promote slowing down production process and increasing product quality and keepsake value (Fletcher, 2008). While counteracting the fast-pasted system of fashion industry, the concept suggests a slower way of living and sustaining traditional arts using eco-efficient approach (Faud-Luke, 2005). Chinese arts and crafts are facing decline and in need of proper conservation and revitalization. Chinese Su Xiu embroidery has been known for its fine stitching and vivid appearance (Zhu, 2987). It is designed with silk floss on silk fabric and limited to producing decorative home furnishings. The overall goal of this design research was to celebrate and sustain the spiritual and material civilization of the Chinese culture by creating a modern artistic interpretation of Chinese embroidery using an environmentally conscious approach that is applicable to apparel design. This research created modern surface design on a group of garments from traditional Chinese Su Xiu embroidery, physical resist techniques, and natural dyes. As the most important medium in dyeing, water was used as inspiration in the forms of water drops and ripples for both garment silhouette and embroidery pattern.

In this project, traditional Chinese surface design techniques were sustained using eco-efficient approaches. Based on the traditional Su Xiu stitches, the embroidery technique used in this garment took advantage of the different fiber reactions to dyes to create color value transition. With the aid of acid and iron pretreatment, each type of embroidery floss was able to create three different shades of color after dyeing. Also, the Chinese physical resist technique of pole-wrapping was reinterpreted to add visual interest to the overall garment design. The techniques used in this garment eliminated the process of dyeing individual colors for embroidery floss in the traditional method. To maintain eco-efficiency, woad and madder dye, non-toxic chemicals, and simplified production process were applied.



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Silk habotai fabrics were pretreated with iron to receive a darker color when dyeing. To illustrate the image of still water drops, four Su Xiu stitches were applied: parallel, single-variegated, raised, and random stitches. For the front bodice side panels, undyed embroidery floss was stitched onto undyed silk habotai fabric using a traditional Su Xiu frame. Then, the stitched pieces were pre-soaked in water and fully immersed in madder dye bath. The center front gathered panel was dipped in madder bath at both ends to create an ombré effect. To create water-like wave patterns on the bottom of the skirt panels, the fabrics were vertically wrapped onto plastic cylinder (pole-wrapping) with string, soaked in water, and then dyed in a madder bath. The dye silk habotai fabrics were hand washed with textile detergent and air-dried. After drying, the silk habotai for the skirt panels preserved its wrinkled texture resulting from the pole-wrapped resist.

Woad over-dye was used to create the blue colors in silk organza of the garment. The shoulder yoke pieces were dyed in a madder bath for 1 hour and overdyed with woad for 1 minute to create a dark blue color. The waist sash was dyed in a madder bath for 1 hour and was dipped in a woad bath for 1 minute only at the mid section. The yellow toned color from madder transitioned into the blue color from woad in an ombré effect. In finishing, woad dyed fabrics were neutralized before hand wash and air drying.

The dropped waist seam and contrasting colors divided the negative spaces in the garment to create positive spaces for the embroidery detail. The garment can also be worn with the waist sash to enhance the shape of an hourglass. Overall, the simple and elegant style lines, embroidery, and resist patterns in the garment further supported the central theme of the serene yet rippled water.

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Naturally Refined Series: Disturbed

Lushan Sun, Designer  
Sherry Haar, Faculty Mentor  
Kansas State University, USA

Keywords: Slow design, sustainability, embroidery, natural dye, resist

As our world draws more attention to sustainable approaches in various aspects of society, slow design is proposed after the slow food movement to promote slowing down production process and increasing product quality and keepsake value (Fletcher, 2008). While counteracting the fast-pasted system of fashion industry, the concept suggests a slower way of living and sustaining traditional arts using eco-efficient approaches (Faud-Luke, 2005). Chinese arts and crafts are facing decline and in need of proper conservation and revitalization. This study focused on two traditional Chinese techniques, Su Xiu embroidery and Jia Xie fold and clamp resist. Chinese Su Xiu embroidery, is known for its fine stitching and vivid appearance (Zhu, 2987). Jia Xie is recognized for its Chinese opera inspired prints and unique production process historically in Southeastern China (Zhang, 2006). Traditionally, Su Xiu is created with pre-dyed silk floss on silk habotai fabric with limited production in decorative home furnishing, and the folding and clamping resist is only applied on cotton. The overall goal of this design research was to celebrate and sustain the spiritual and material civilization of the Chinese culture by creating a modern artistic interpretation of Chinese traditional arts using an environmentally conscious approach that was applicable to apparel design. This research created modern surface design on a group of garments from traditional Chinese Su Xiu embroidery, physical resist techniques, and natural dyes. As the most important medium in dyeing, water in the form of splashes was the inspiration in designing the garment silhouette and layout of the embroidery patterns and resists.

To sustain the characteristic of smooth color value transition in traditional Su Xiu, the embroidery technique used in this garment took advantage of the different fiber's (silk, wool and cotton) reaction to natural dyes madder and woad to create similar results. Also, each type of embroidery floss was divided in to three groups, each pretreated with aluminum sulfate and iron, or acid in order to achieve three shades of color when dyeing, nine shades in total. Further, the folding and clamping resist technique was reinvented with two flat wooden blocks to create teeth-like pattern on the fabric.



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Overall, the techniques applied successfully eliminated the process of dyeing individual color for embroidery floss and included the physical resist pattern to add visual interest to the overall garment design. In this garment, an eco-efficient approach was also applied through use of woad and madder natural dye, non-toxic chemical, and simplified production processes.



To create the water splash pattern, five traditional Su Xiu stitches were applied: parallel, single-variegated, raised, spiral, and random stitches. Cotton sateen and silk organza fabrics were stitched with undyed floss onto undyed fabrics using a traditional Su Xiu frame. The embroidered cotton sateen waist yoke fabrics were dyed in a madder bath for 1 hour and overdyed in woad bath for 1 minute. The silk organza used for the top layer of the skirt and outer layer of bodice were folded vertically, clamped between flat wooden blocks, and dyed in madder. The silk organza fabrics for the skirt under layer and second layer of the bodice were dyed with madder to achieve copper-red color then overdyed with woad for 5 second to achieve the rich brown color. The same technique was applied to the remaining skirt and bodice pieces, but with a 1 minute dip in the woad bath to achieve a gray-black color. The cotton sateen under skirt was immersed in the madder exhaust bath achieves a light shade of red-copper.

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