Textiles in three dimensions: an investigation into processes employing laser technology to from-led three-dimensional textiles

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TEXTILES IN THREE DIMENSIONS: AN INVESTIGATION INTO PROCESSES EMPLOYING LASER TECHNOLOGY TO FORM DESIGN-LED THREE-DIMENSIONAL TEXTILES

CREATIVE DISCIPLINE: Textile design

RESEARCH METHODS:
• Contextual review
• Action research
• Reflective practice
• Scientific methods

NUMBER OF DESIGN CASE STUDIES UNDERTAKEN BY THE RESEARCHER: 3

LENGTH OF THESIS: 66500 words

EXAMINATION FORMAT: Thesis and oral examination

DURATION OF STUDY: 5 years full time

EXPERIENCE OF DESIGN PRACTICE BEFORE START OF PHD:
• City and Guilds I & II in Creative Embroidery (5 years)
• Bachelors degree in Multi-Media Textile Design (BA (Hons) 3 years)
• Freelance Textile Designer/Maker (10 years)

PERSONAL MOTIVATION FOR UNDERTAKING PRACTICE DURING PHD:
• Wished to acquire in-depth knowledge of laser-processing of textile materials for textile practice
• Desire to develop processes involving lasers for the making of three-dimensional textiles that would be communicable to and directly applicable by textile design practitioners
• Desire to contribute to developing robust research models in the domain of textile design research

AIM OF THE RESEARCH:
The aim of the research was to develop processes to pleat previously laser-cut fabric and determine process using lasers to make three-dimensional textiles

RESEARCH QUESTIONS:
• What historical and contemporary three-dimensional textiles have been made and what techniques are used to produce them?
• How is laser processing employed in textile design and manufacturing? What new opportunities are there?
• Can a process be developed to automate or speedup the production of laser-cut and pleated designs?
• How can negative laser processing effects on natural fibres be mitigated?
• Can additive manufacturing techniques be applied to textile substrates?

OBJECTIVES:
Conduct a contextual review to:
• Determine what historical and contemporary three-dimensional textiles have been produced and which techniques were employed
• Examine in which ways and for which purpose laser processing has been applied to textiles
• Consider what trends will impact on future textile design and manufacture
• Acquire an in-depth knowledge of laser materials processing particularly for textile materials
• Develop new processes incorporating laser processing to create three-dimensional textiles
• Communicate all knowledge in a form that will be accessible to the textile design community
SUMMARY:
This cross-disciplinary PhD was supervised by both a school of art and school of engineering. A contextual review was undertaken to determine how and where laser processing was employed for textile design and manufacture and what techniques had been used for historical and contemporary three-dimensional textiles. Although embedded in textile manufacturing for cutting and surface decoration, further take-up by the textile industry of laser processing was inhibited by negative process effects. Furthermore, knowledge was not in the public domain in a form accessible by textile designers. Three-dimensional textile analysis characterised techniques as processes that fabricate textiles with a three-dimensional form, achieve three-dimensionality by the addition or removal of material, or manipulate a two-dimensional surface to create one with three-dimensionality. Designers have the opportunity to use any or all of these to innovate at many levels.

The PhD explored processes to generate three-dimensional textiles incorporating laser processing using three approaches:

- The investigation and development of a historical textile technique
- A focus on mitigating negative effects of the laser process
- The application of a non-textile process to textile materials

Three new processes were developed. These were illustrated and extended through textile design and the introduction of new materials. The research documents methods for communicating the outcomes of textile design research and addresses issues in cross-disciplinary research.

RATIONALE FOR THE INCLUSION OF DESIGN PRACTICE UNDERTAKEN BY THE RESEARCHER:
Design practice is integral to this PhD research. It is used to generate research questions, initiate and progress action research cycles, seek or test solutions to problems, illustrate outcomes, and, is fundamental to communicating outcomes to the textile design community. Knowledge of textiles laser processing is not generally accessible by textile designers due either to the form in which it is published or to research and design being carried out by industry and not being made generally available. Opportunities to experiment are limited due to lack of access to equipment and costs. Integrating design practice with an action research methodology provides a model to both further textile design and, at the same time, to capture the results of cross-disciplinary research so that novel developments may be noted, replicated and communicated.

HOW THE PHD DESIGN PRACTICE DIFFERED FROM THAT OF COMMERCIAL PRACTICE:
Commercial textile design practice is concerned with the production of unique collections of designs for sale to the fashion or interior industries. Individual designs may be further developed or altered, with or without the input of the designer. They may be purchased as inspiration for collections and may or may not be put into textile production. In commercial practice, the design cycle culminates in the production of commercially viable designs. This inevitably restricts outcomes through for example, materials used or number of colours employed. Whilst conducting the PhD, the consideration of commercial constraints was removed. Design practice was used as a vehicle to generate research questions, develop ideas, test results and as a means of validating the viability of new processes. Consideration was not given to commercial aspects such as trends, cost of production and viability of mechanised manufacturing processes. Together with the thesis, design practice was used as a means of communicating the results of the research which would not necessarily occur in commercial practice as steps would be taken to protect the intellectual property for both designs and processes.

THESIS AVAILABLE AT: http://hdl.handle.net/2134/9038

CONTACT DETAILS: Loughborough University, UK (J.Matthews@lboro.ac.uk)
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