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Structural textiles: adaptable form and surface in three dimensions

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CASE STUDIES IN THE USE OF DESIGN PRACTICE BY PHD RESEARCHERS

DPR
 case studies

STRUCTURAL TEXTILES: ADAPTABLE FORM AND SURFACE IN THREE DIMENSIONS
CREATIVE DISCIPLINE: Textile design

RESEARCH METHODS:

- Contextual review
- Literature review
- Action research
- Reflection-in-action
- Auto-Ethnography

NUMBER OF DESIGN CASE STUDIES UNDERTAKEN BY THE RESEARCHER: 4

LENGTH OF THESIS: 40000 words

EXAMINATION FORMAT: Thesis, exhibition of practical work and oral examination

DURATION OF STUDY: 6 years part-time

EXPERIENCE OF DESIGN PRACTICE BEFORE START OF PHD:

- Bachelors degree in Printed Textiles
- Designer of Printed Textiles for Fashion for companies including Lewis & Lewis Design, Jonathan Saunders, New Leaf Design, and Palm Studios. (5 years)
- Freelance Designer/Maker/Illustrator (7 years)

PERSONAL MOTIVATION FOR UNDERTAKING PRACTICE DURING PHD:

- Desire to further develop processes for creating 3-D textiles using 2-D processes such as silk-screen printing
- Wish to expand skills in and knowledge of textile and non-textile design and making processes
- Desire to spend a discrete period of time focused solely on experimental design research and practice

AIM OF THE RESEARCH:

The aim of the research was to develop production processes for the creation of novel textiles capable of sustaining adaptable, three-dimensional form with little or no supporting substructure. The intention was to evolve versatile, transformable textile structures in diverse scales with customisable functionality transferable to a range of applications.

Many 3-D textile structures are a two-part construction of 'mesh & membrane'. The creation of a self-supporting textile that integrates the 'mesh' and the 'membrane' into a single, streamlined system eliminates any risk of the misalignment or disconnection presented by the two-system structure and potentially improves the aesthetic of the material.

RESEARCH QUESTIONS:

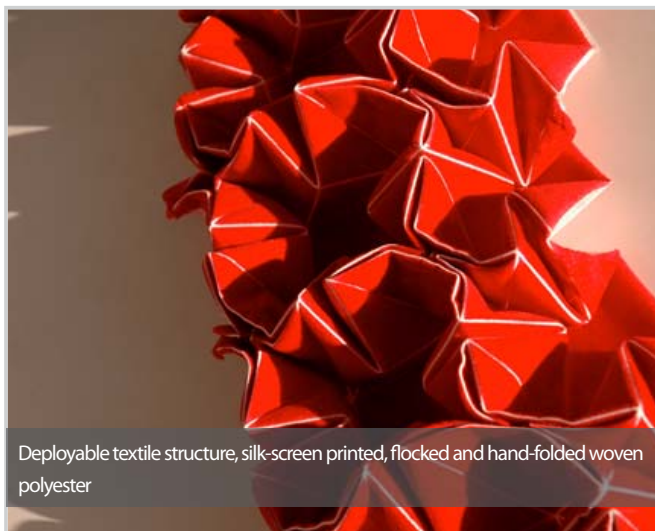
- What are the present and the potential applications for adaptable and deployable 3-D textile structures?
- What are the generic principles underlying the folding patterns of adaptable and deployable structures?
- How might current industrial production processes and materials both within and external to the discipline of textiles be used, combined or adapted to create permanent, self-supporting folds on textile substrates in a range of scales?
- How might current industrial constraints, such as limitations to piece size, modular scale and speed of manufacture, be mitigated?

OBJECTIVES:

- To develop an insight into contemporary design, production and application of three-dimensional, adaptable and self-supporting folded structures both within and external to the discipline of textiles
- To develop adaptable and self-supporting, three-dimensional structures, as well as production processes and materials for the realisation of these structures as textile forms
- To develop a transferable model of design that could be adapted to create adaptable 3-D textile forms suit a range of situations
- To develop a research methodology that could encompass both the theoretical and practical aspects of the research project



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 Professor Martin Woolley



Deployable textile structure, silk-screen printed, flocked and hand-folded woven polyester



Self-folding textile: silk-screen printed polyester lycra jersey



Deployable textile structure with shape-memory: composite material formed using laser cutting and hand making techniques

SUMMARY:

This PhD explored the potential of predominantly 2-D processes to create adaptable 3-D textile structures. Visits to industrial facilities in the UK and Japan, and information gathered at conferences, symposia and trade fairs enabled the analysis and evaluation of established processes for the production of folded structure on textile and non-textile substrates. A literature review assisted the framing of the project with reference to philosophies of folding and 'design thinking'. Studio practice, combining textile and non-textile production techniques investigated, evaluated and adapted industrial processes. Careful documentation of this practice allowed reflection on and analysis of the role of tacit and embodied knowledge in the design process. The small incremental modifications made led to the development of unconventional hybrid textile processes that blurred boundaries between printed and constructed textile approaches as well as extending into other disciplines. These modified processes, including thermoplastic manipulation, silk-screen printing, stitching and lamination, were used to restructure textile surfaces to give self-supporting structural capabilities as well as shape-memory properties. Feedback given at exhibitions demonstrated that the potential for transferable application of the physical outputs of the research was recognised by people in areas including sportswear, costume design, architecture, solar harvesting and electronic engineering.

RATIONALE FOR THE INCLUSION OF DESIGN PRACTICE UNDERTAKEN BY THE RESEARCHER:

Design practice was absolutely central to the research. 3-D knit and weave were already established textile technologies for creating self-supporting, three-dimensional textile forms but 3-D printed textile techniques had yet to be fully explored.

Developments of 3-D textile structures had more usually originated from material science, engineering and textile technology contexts. However, by building on research carried out by these disciplines to develop folded structures but emphasising a 'poetic', design-orientated outlook I explored the potential for a more intuitive, non-linear approach to highlight hitherto overlooked elements in the design process. By using diverse methods such as studio practice, analytical and creative writing, drawing and film making to compliment the development of the textiles at the core of the research a single concept could be explored from multiple viewpoints. Through the use of such a range of methods seemingly unrelated ideas can be juxtaposed, the cross-pollination creating opportunities for innovation.

The personal and subjective aspects of this approach facilitate examination of emotional and imaginative perspectives alongside technical considerations in ways that can suggest alternative directions of development, broadening the impact of the research beyond purely technical performance issues to include its experiential and expressive aspects.

HOW THE PHD DESIGN PRACTICE DIFFERED FROM THAT OF COMMERCIAL PRACTICE:

The PhD design practice differed from commercial textile design practice as the practice was freed from constraints for the work to be a finished and saleable entity or to follow seasonal industry trends that usually drive the aesthetic of textile materials created for commercial contexts. There was more time to develop ideas and more opportunities to take risks in the development of the textiles and in the evolution of the production processes.

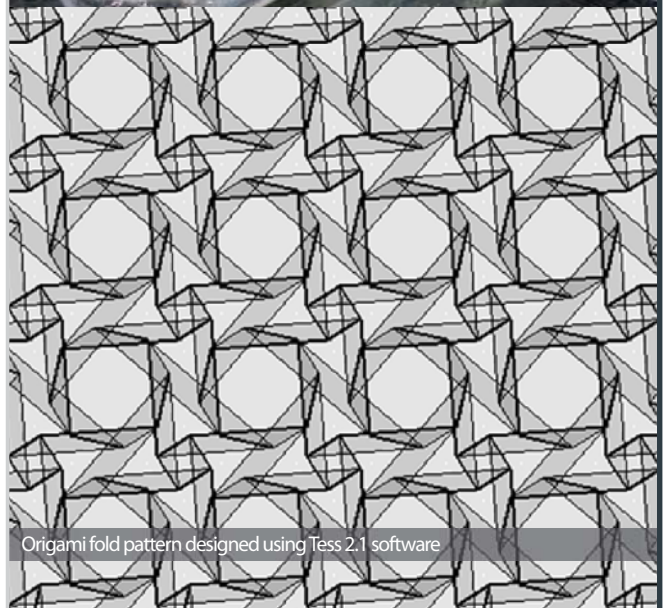
Instead of focusing on prototyping a limited number of specific outcomes for particular applications the research prioritised the development of adaptable design and production process that would be transferable to a number of different disciplines. This was achieved through the creation of an open-ended series of design iterations that investigated the research questions, each iteration acting as a catalyst for concept development rather than functioning as a finished design outcome for a commercially viable textile.

THESIS AVAILABLE AT: <http://researchonline.rca.ac.uk/id/eprint/434>

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Deployable textile structure with shape-memory: composite material formed using laser cutting, foiling and hand making techniques



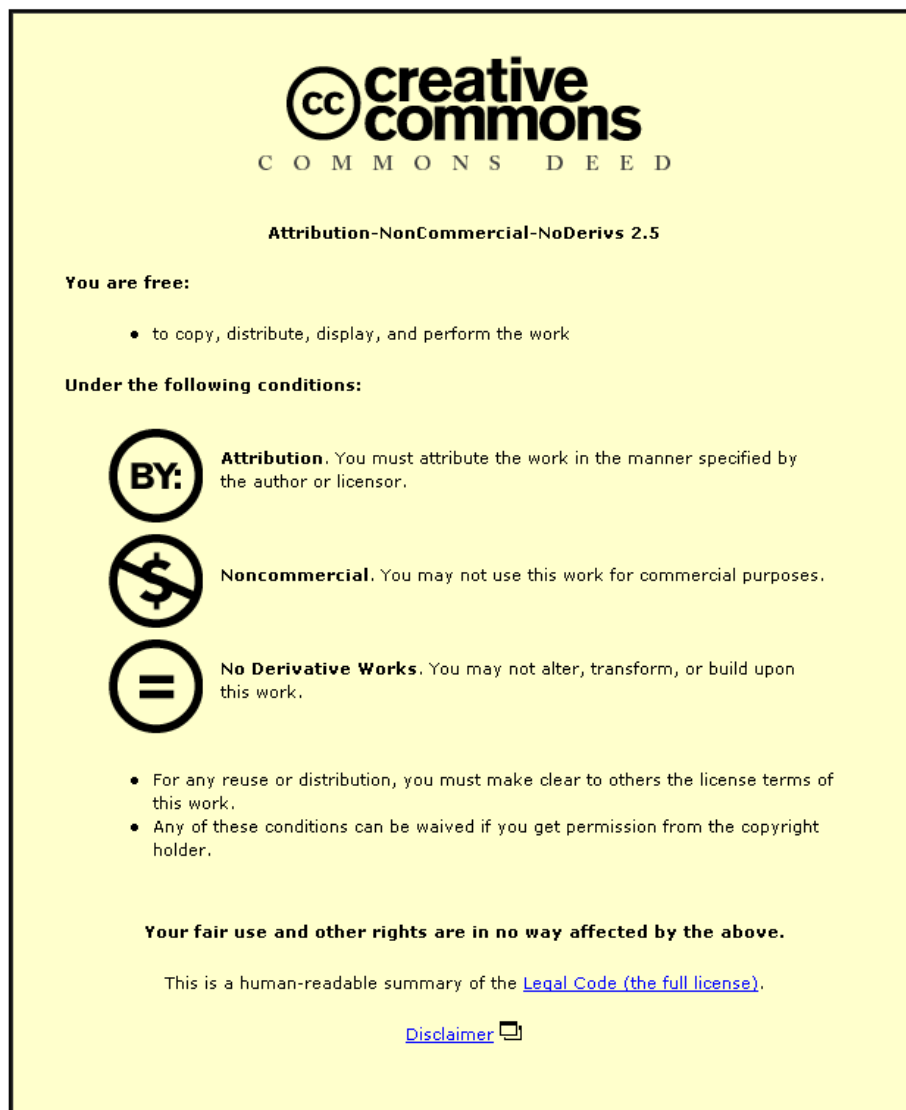
Origami fold pattern designed using Tess 2.1 software



Moulded, transfer-printed, polyester coated cotton lawn, hand-folded from a CAD-designed origami net

Design Practice Research Case Studies have been compiled by the Design Practice Research Group at Loughborough Design School. If you would like to work with us or contribute a case study, please contact the Design Practice Research Group Leader, Dr Mark Evans (M.A.Evans@lboro.ac.uk).

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