A digital garment simulation tool for fashion design linking consumer preference and objective fabric properties

Project Team

University of Leeds

Ningtao Mao
Textile and clothing Technology

Neil Morrison
Mathematician

He Wang
Computing Science

Zhiqiang Zhang
Electronic Engineering

Industry partner

BURBERRY
LONDON ENGLAND

Contact

Ningtao Mao
University of Leeds
N.Mao@leeds.ac.uk

Garment simulation modelling for the UK fashion industry

Virtual garment simulation is a rapidly evolving technology, which has the potential to both shorten the fashion design process and be used to visualise clothing for online shopping. Currently, computer simulations provide only poor imitations of the real garments; missing details, such as how a particular fabric drapes and feels, are related to its mechanical properties. Fashion garments are frequently evaluated by consumers subjectively with respect to these qualities, so achieving a more realistic simulation of those two qualities linked with the mechanical properties of a specific fabric will be a big step forward, enabling better communication between consumers, designers and manufacturers. This will enable garment designers to acquire valuable feedback about which fabrics to use to achieve a desired customised product or a desirable mass market garment.

The project is the first to connect consumer’s sensory preferences for a garment’s drape and feel to the fabric’s objective qualities in a computer simulation model.
Towards more realistic garment simulation modelling

It has been found that fabric buckling properties, now measurable using the newly developed instrument LUFHES (Leeds University Fabric Handle Evaluation System), characterise not only fabric deformations (how it drapes) but also tactile properties (how it feels).

The project was based on the proposition that incorporating fabric buckling data into the algorithm for computer simulation of garments will produce a more realistic result.

LUFHES (Leeds University Fabric Handle Evaluation System)
This was achieved in a number of steps:

**Building a computer simulation model:** The Abaqus software was used to build initial computer simulation models based on a fabric’s mechanical (elastic and plastic) properties for both pre- and post-fabric buckling.

**Collecting fabric buckling data:** Buckling deformations of various fabrics were tested using LUFHES. Differences in deformations, with fabrics with varying elastic and plastic properties, were compared and validated.

**An optimisation algorithm was developed:** A generic Finite Element Analysis (FEA) approach and algorithm were developed which could improve the simulation models on the basis of the fabric buckling data for a specific fabric. For a given set of inputs, it was found that 20 to 30 iterations of simulation cycles were sufficient to achieve a good result. This judgement was based on objectively validated tests of the differences between the simulation and observed fabric deformations.

Objective tactile properties have already been shown to be closely associated with subjective ‘feel to touch’ of fabrics. Therefore, use of fabric buckling data, to provide an enhanced simulation, has the potential to aid communication between consumers, designers and manufacturers.
The EPfunded Network Plus Connected Everything: Industrial Systems in the Digital Age aims to identify the key challenges we face as digital technologies transform our industrial systems.

### Key finding 1
Fabric buckling properties provides a basis for both
1) Visual simulation of fabrics
2) Objective descriptions of fabrics' tactile properties

### Key finding 2
The generic Finite Element Analysis approach and algorithm developed were able to improve the simulation models using the fabric buckling data from a specific fabric.

### Wider applications
The FEA models and approaches developed in this project can be applied to the simulation of textile products in other contexts (such as for medical and healthcare textile products, tissue engineering products, curtains, bedding and furniture used in home interior design and for textiles used by the automotive and medical sectors). They can also be used to improve the visualisation of fabrics in computer game design, animation and in the film industry.

### What next?
- Develop digital garment simulation tools for specific user groups, such as fashion designers, or consumers of specific types of fabric products such as sportswear or underwear that sits on the skin.
- Garment simulation models could be refined using ‘big data’ sets collected through online shopping.

### Further funding achieved
This research helped the University of Leeds secure a Creative Industry Clusters Programme from the Arts and Humanities Research Council. £5.4M was awarded in October 2018 for a ‘Future Fashion Factory’ project to digitalise the fashion and textile industries in the Leeds area.