A digital garment simulation model to link consumer preference to objective fabric properties

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EPSRC Engineering and Physical Sciences Research Council

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Objective

To develop a garment simulation model which connects consumer preference (visual æsthetics and sensory feel) to objective fabric properties.

Background and motivation

UK textile and fashion industries contribute £26 billion to the UK economy, and account for 2.8% of employment. These industries rely on the successful combination of creative design, technological innovation, and mass manufacture, in tandem with consumer feedback and market research.

However, there are two key aspects in which the development of a more realistic garment simulation tool would be of great benefit.

- ***CONSUMER FEEDBACK***

  Fashion products are evaluated by consumers' subjective sensory responses to the fabric, often involving vague terminology and unquantified relative ratings. Furthermore, no method is available in the supply chain to characterise the objective tactile properties of the component materials. Thus there are difficulties involved in incorporating consumer feedback data into the design process, and, consequently, in providing consumers with customized fashion products to suit their particular preferences.

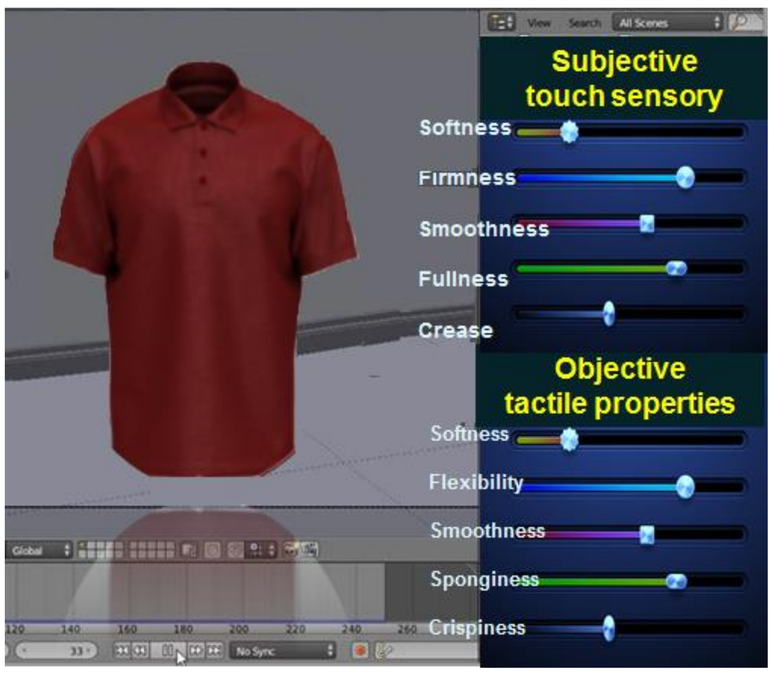
  Our project aims to alleviate these difficulties by establishing quantitative links between consumer preferences and objective material properties.

- ***CONSUMER EXPERIENCE***

  Computer representations of garments used by online shopping platforms do not relate to the formability of the component materials, nor do they account for tactile/comfort fabric properties.

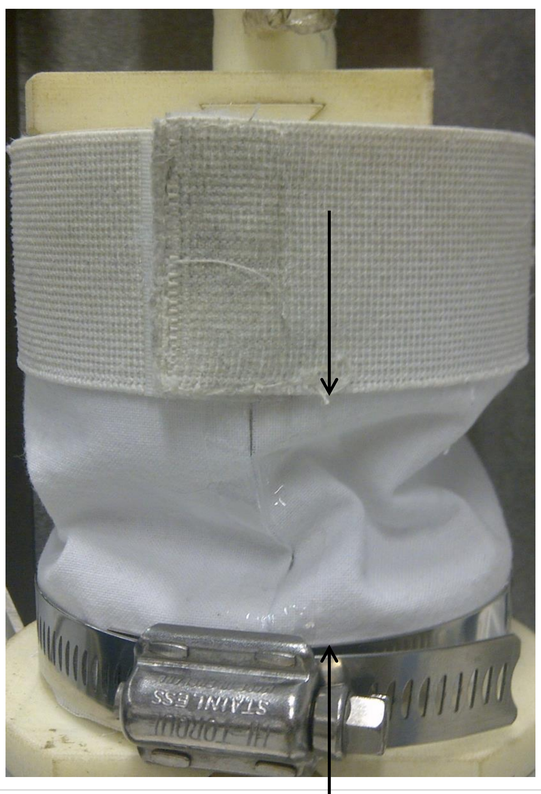
  Also, existing simulation tools do not accurately model the dynamic draping of garments, and thus do not provide shoppers with a sufficiently realistic visual representation of the physical garment. This leads to a high proportion of returns of items purchased online, with associated costs of postage & packaging expenses and lost sales.

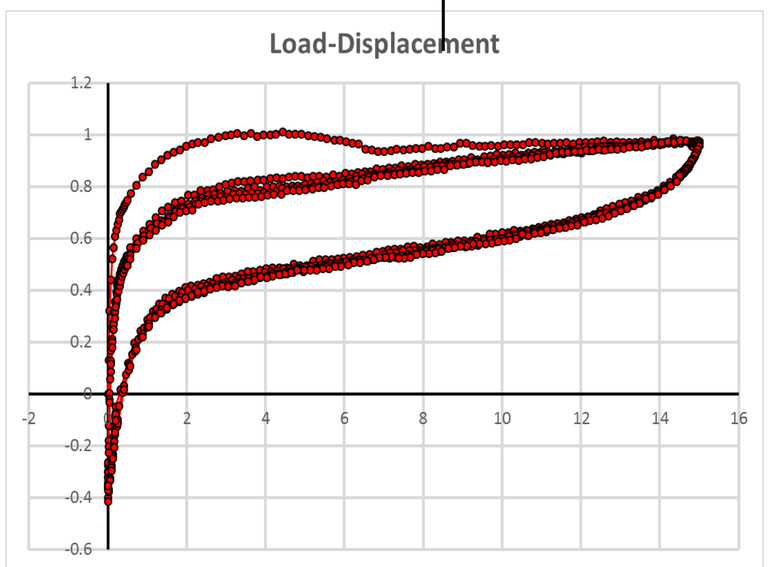
  Our project aims to reduce these costs to the industry by providing consumers with a more realistic online shopping experience, incorporating meaningful tactile aspects.



Fabric characterisation

It has been found that fabric buckling, which is now measurable using the newly developed instrument -- LUFHES (*Leeds University Fabric Handle Evaluation System*), together with other fabric properties characterises not only fabric deformation (how it drapes) but also tactile properties (how it feels). Therefore, incorporating compressional and torsional fabric buckling data into computer simulation algorithms will produce more realistic garment behaviour both qualitatively and quantitatively.





By harnessing recent advances in machine learning, links can be made between consumers' subjective responses and the objective properties of various fabrics. Optimization techniques can be used to identify the general empirical relationship between the subjective preferences of consumers and the objective material model parameters.

Improved garment simulation

Virtual garment simulation is a rapidly evolving technology which has the potential to shorten the fashion design process, and to aid visualisation of clothing for online shopping.

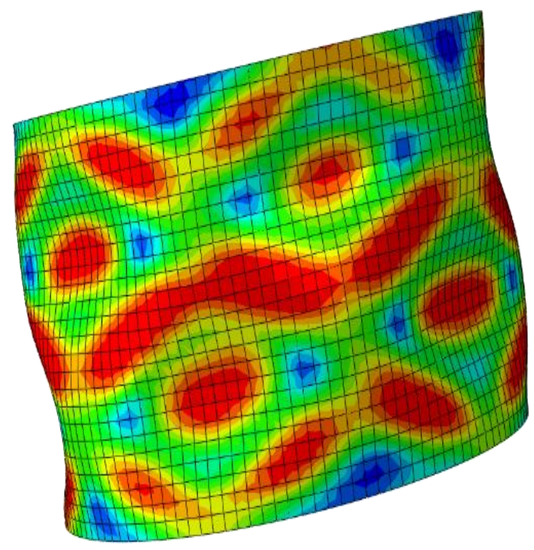
Existing computer simulations of garments provide only pale imitations of the real garment behaviour, missing important details such as how a specific fabric drapes and feels.

In this project, objective fabric properties characterised using the newly developed instrument (LUFHES) will be incorporated into a simulation algorithm, in order to connect consumers' subjective sensory preferences for a garment (drape and feel) to the objective fabric properties.

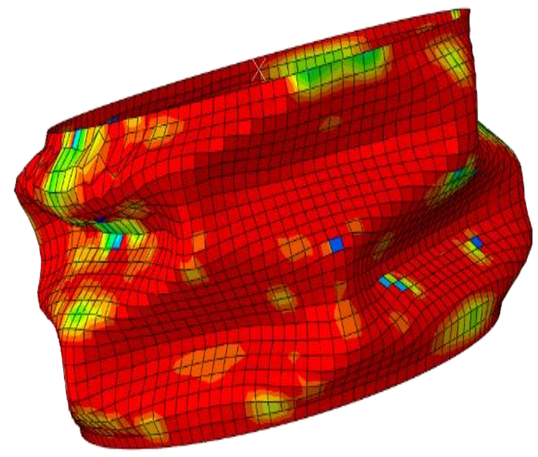
This will enable fashion designers to acquire valuable quantitative consumer feedback, and help to achieve desirable customised clothing products for fashion and the mass market.

A particular fabric is modelled as a non-linear elastic material with appropriate parameters for finite-element simulations of buckling deformations based on load response (stress-strain) obtained experimentally from the LUFHES.

Early stage buckling:



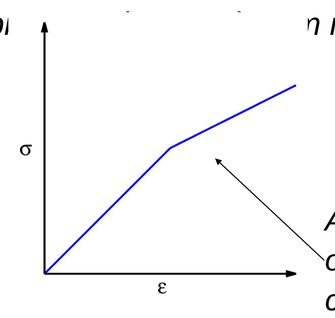
Late stage buckling:



Repl *n model:*

$$\sigma_{ij} = c_{ijkl}\varepsilon^{e}_{kl}$$

$$\varepsilon = \varepsilon^{e} + \varepsilon^{p}$$



Adjust dimensions & shape of curve based on optimal comparison to experimental data

More diverse continuum material models for the fabric will also be considered for incorporating viscoelastic and frictional behaviour.

Further applications

Improved computational modelling and visualization of fabric behaviour may be beneficial in other textile industries, such as interior design (buildings and vehicles), and in sectors with bespoke textile needs (e.g. medical, military). Other applications include more realistic CGI for video games and films.

Acknowledgments

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