Vision Helps Touch:
Pseudo-Haptic Effects for Conveying Fabrics Properties

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***Abstract*— This research investigates how elasticity and weight of fabrics can be conveyed through pseudo-haptic effects. Here, pseudo-haptics is delivered through interactive visualizations using 'shoogles' that simulate the real-life interaction of the hand with a fabric by altering the fabric movement at the click of the mouse, based on a variable control/display ratio (or gain value).**

I. Introduction

The sense of touch represents an essential part of our daily interactions, such as for making purchasing decisions [1], [2]. However, it is currently difficult for online shopping to communicate the tactile qualities of products involving complex materials such as fabrics [3]. Perception of fabrics and apparel made from them is multisensory, primarily driven by visual and tactile information. Recent studies have shown that it is possible to use visual stimuli to simulate the experience of touch [4].

We refer to pseudo-haptics as the use of touch-based illusions created by cross-modal perceptual interactions, altering the visual feedback of the hand (or mouse cursor). Existing work to convey physical properties of fabrics via pseudo-haptic effects have relied on static images, stop-motion animations, or computer-generated images. In contrast, our novel approach uses interactive images, so-called 'shoogles' (i.e., sequence of photographs) for conveying elasticity and weight of fabric samples. The benefit of this approach is that visual material properties can be realistically conveyed through a 'visualized touch'.

II. Methods

To create our pseudo-haptic shoogle stimuli, the first author manipulated a fabric sample. For the weight stimulus, the sample was moved up from a table's surface. For the elasticity stimulus, the sample was held in both hands with the right hand pulling the sample horizontally (see Fig. 1). The interactions with the fabrics were photographed using burst-mode to capture 20 frames per stimulus representing the respective motions for weight and elasticity.

Next, the frames were processed through a p5.js script (JavaScript creative library) to enable interaction using a standard computer mouse. Horizontal movement of the mouse cursor resulted in each frame being presented sequentially giving the impression of the user controlling the movement of the arm in the picture sequence.

The pseudo-haptic effects for weight and elasticity were realized through a variable gain setting. Higher gain values necessitate moving the mouse over a larger distance in order to progress to the next frame in the sequence. Perceptually, for the weight stimulus, this makes the fabric feel heavier. For the elasticity stimulus this makes the fabric feel less elastic. We conducted a study to verify these assumptions.

Study outline

The task in the study was to rate the perceived elasticity and weight (on a 7-Point Likert Scale) by interacting with 5 interactive visualizations (each presenting an incremental gain, from 0,25 to 4 for the *elasticity* and from 0,5 to 2 for the *weight*). In the study, participants used their mouse to interact with visualized fabrics and to give a rating.

Figure 1. On the left. The elasticity interactive visualization; In the middle, The elasticity interactive visualization after user manipulation (with gain value = 4; stiffer); On the right. The elasticity interactive visualization after user manipulation (with gain value = 0,25; more elastic).

A sample of 41 users tested both elasticity and weight interactive visualizations in the university laboratory. Randomization of the 5 interactive visualizations ensures that each subject has an equal chance of receiving any treatment without bias. From an initial analysis of the raw data, the relations between gain values and perceived weight / elasticity both were found to be monotonic and confirming our assumptions.

III. Conclusion and future work

This study represents the first attempt to convey the physical properties of fabrics through shoogles and pseudo-haptic effects. We also planned an experiment 2, a mixed experiment where users first interact with real and then digital fabrics.

References

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