Digital Stitching for Variable Textile Properties

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Computer-controlled embroidery design and stitching for Precision Control of Tensile Properties of woven textiles

Market Overview

Computer-controlled embroidery algorithms allow for custom design and control properties of fabrics and woven materials. Embroidery changes the mechanical properties of frabrics, depending on the strength, orientation, and distribution of stitches. The production of fabrics with multiple, distinct properties traditionally requires the assembly of layers of different materials through seaming. As a result, production can only be done at a small scale. Clemson University researchers have developed a computational fabrication system that allows for the customization of material properties of fabrics at a larger scale. By utilizing a novel path planning algorithm, the system creates a stitch design that, when added to the fabric, changes the stiffness of the material based on the design needs. This customization can be used to produce custom seating, footwear, and smart clothing.

Technical Summary

The use of computer-controlled embroidery allows for the customization of the tensile and material properties of fabrics. This technology utilizes a novel path planning algorithm that generates a stitching design that controls the textile's local stiffness. The stitch planning problem used is comparable to the coverage planning in robotics, or the Travelling Salesmen problem, and creates a stitch layout using a series of variable stiffness embroidery blocks (EB). For a finer resolution, stiffness is controlled at the stich-level (SL) through density maps, path planning, and stitch density. Computational fabrication allows for the scalable production of customized fabrics for shoe insoles, bedding, wheelchairs, and clothing.

Application

Computational fabrication and precise control of fabric tensile and mechanical properties

Development Stage

Prototype System

Advantages

- Novel path planning algorithm maps out a stitch design for the fabric
- Gradients and layers of stitches precisely alter the mechanical and tensile properties of the textile
- Computational fabrication allows for textile customization at a larger scale than previously measured

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/862,037	NA	2018-040	Dr. Victor Zordan, Ella Morre, Michael Porter, Ioannis Karamouzas

About the Inventors

Dr. Frank Alexis

Professor of Computing at Clemson University

Dr. Victor Zordan is the Program Director of Digital Production Arts and is faculty and division chair for Visual Computing within the School of Computing at Clemson University. Victor works on developing techniques in graphics, fabrication, and animation with focii in physically based modeling, interfaces, and human animation. He has been an enthusiast and graphics programmer for more than thirty years and a researcher investigating animation techniques for more than twenty. His interests are in physical simulation, motion capture, and algorithms used to create believable (and unbelievable) motion and to explore novel uses for animation in electronic games, medical and training applications, and virtual worlds. Dr. Zordan received his PhD from Georgia Tech at GVU. Dr. Victor Zordan is former faculty in the department of Computer Science and Engineering at University of California Riverside where he directed the Riverside Graphics Lab.

For more information on this technology contact:

Andy Bluvas
Technology Commercialization Officer
E: bluvasa@clemson.edu
P: (864) 656-05157