Karma Chameleon: Jacquard-woven photonic fiber display

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ABSTRACT
Karma Chameleon is a photonic textile display woven on a Jacquard loom, using photonic bandgap fibers that have the ability to change color when illuminated with ambient or transmitted light. The use of double weave structures allows us to further modulate the color and patterns on the textile.

Keywords
Photonic displays, electronic textiles, photonic bandgap fibers, Jacquard loom

INTRODUCTION
The field of electronic textiles has entered the mainstream in recent years but the predominant implementation model still usually consists of layering electronic or mechatronic functionality on top of a textile substrate. Prior work exists in the domain of stitching, weaving, or knitting with conductive yarns to create structures such as electrodes, sensors, or communication lines and subsequently attaching electronic components to that substrate. Few functional yarns (other than conductive or resistive yarns) are currently available commercially to enable functionality such as the display of information, sensing, or energy harnessing in a textile. The ability to integrate the desired functionality on the fundamental level of a fiber remains one of the greatest technological challenges in the development of smart textiles.

JACQUARD WEAVING
A Jacquard loom allows the weaver to individually address each warp thread so as to create complex weave structures including double and pocket weaves to separate different weft threads into separate layers. Double weave is a type of woven cloth in which two warps and two sets of weft yarns are interconnected to form a two-layered cloth. We use a cotton weft together with a PBG fiber weft, to create individual illuminated images in the textile display.

PHOTONIC BANDGAP FIBERS
We have been weaving a novel type of optical fibers, called photonic bandgap (PBG) fibers, on a computer-controlled electronic Jacquard loom, in order to produce a dynamic textile display. PBG fibers can be designed to reflect one color when side illuminated with ambient light and emit a different color when transmitting light. By mixing the two colors, one can dynamically change the color of an individual fiber by controlling the relative intensity of guided and ambient light. This allows for creative opportunities in the application of photonic textiles under changing ambient illumination conditions. To implement a PBG fiber-based textile capable of changing its emissive color one can employ a braid made of 3 Bragg fibers having red (R), green (G) and blue (B) emissive colors.

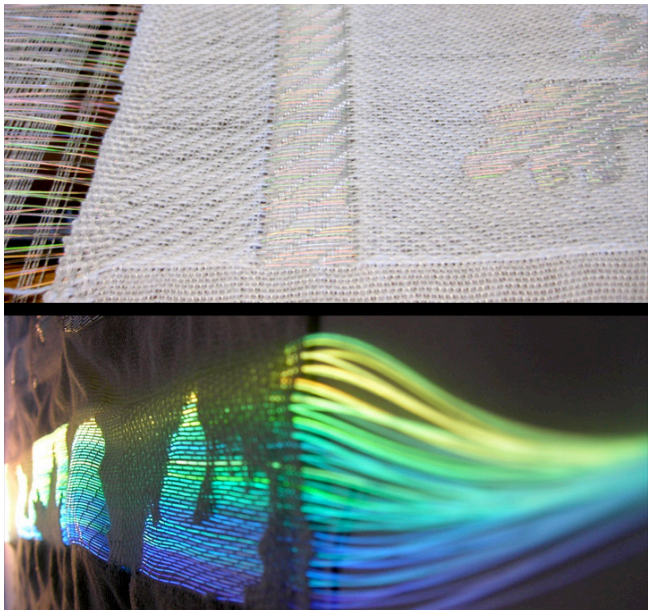

Figure 1. Two early prototypes, the first illuminated by ambient light, the second with transmitted light

FUTURE WORK
Key challenges involve tuning fiber fabrication machinery for production of a long fiber of a fixed color; better understanding of relationship between guided color, reflected color, and fiber geometry; development of improved weaving techniques; and the study of a textile's visual and tactile properties as a function of textile fabrication parameters.

REFERENCES
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SIGGRAPH 2009, New Orleans, Louisiana, August 3–7, 2009.
ISBN 978-1-60558-726-4/09/0008