Stitched actuators for smart garments

A new e-textile actuator integrates shape memory materials into standard stitches for seamless garment actuation.

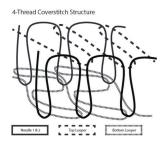


Figure 1: Coverstitch Structure Diagram

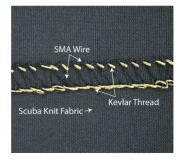


Figure 2: Robo-Coverstitch Close Up Shot

Technology ID

2023-242

Category

All Technologies
Engineering & Physical
Sciences/Instrumentation,
Sensors & Controls
Engineering & Physical
Sciences/Materials
Engineering & Physical
Sciences/Processes
Engineering & Physical
Sciences/Robotics
Life Sciences/Biomarkers
Life Sciences/Human Health

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IP Status: US Patent Pending 19/470,221

Applications

- Garment-based soft joint braces
- Dynamic compression garments
- Wearable accessibility solutions
- Shape-changing garments (e.g., shapewear, aerodynamic & performance wear, etc.)

Key Benefits & Differentiators

- Easy to manufacture: Utilizes traditional sewing equipment and techniques, unlike conventional actuation methods.
- **Functionally integrated:** The shape memory material within the coverstitch structure creates an actuator that is an intrinsic part of the garment itself, rather than a foreign component
- Variety of design levers: Offers new methods for creating selectively stiffening, tensioning, or shaping effects by varying materials, stitch patterns, and fabric substrates.

Technology Overview

The integration of actuation into garments is typically achieved with bulky, complex, and difficult-to-manufacture components such as servo motors, pneumatics, or intricate smart material structures. These solutions are often conspicuous, aesthetically challenging, and not well-suited for seamless integration into everyday clothing, which limits their application in commercial, military, and medical fields. Consequently, existing textile-based actuation systems are often considered foreign additions to a garment rather than an inherent part of its design.

Researchers at the University of Minnesota have developed a new e-textile actuator that utilizes shape memory materials (e.g., shape memory alloys) integrated into conventional coverstitches. By replacing one or more of the constituent threads in a coverstitch with a shape memory material, the technology creates an actuator that is seamlessly integrated into the fabric. The

resulting stitched trace changes stiffness, displacement, or tension in response to temperature changes, providing a new way to achieve selective stiffening or shaping effects. This approach enables the production of functional, aesthetically conventional, and low-profile actuators that are far easier to manufacture than existing solutions.

Phase of Development

TRL: 5

Prototypes have been manufactured and tested with various fabric substrates and shape memory alloy stitch patterns.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

 <u>Brad Holschuh, PhD</u> Associate Professor, Department of Apparel Design and Human Factors & Ergonomics

References

 Niharikha Subash, Brad Holschuh(2025), https://www.tandfonline.com/doi/full/10.1080/14606925.2025.2496631, https://www.tandfonline.com/journals/rfdj20