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Textile-based active-sensory skins

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ABSTRACT

Future generations of robots will include systems constructed from soft, conformable materials with embedded function for wearable and/or human-robot interaction applications. In particular, active textiles may be employed in applications, such as wearable computing, proprioceptive feedback, or load augmentation while potentially exploiting many textile manufacturing processes that are already widespread. In this discussion, a preliminary prototype of a robotic fabric with embedded actuation and sensing will be presented. By attaching the same robotic fabric to a soft body in different configurations, unique motions (such as compression and bending) have been demonstrated. The prototype incorporates shape-memory alloy (SMA) wires stitched onto a fabric base to actuate the fabric. Custom-designed hyperelastic strain sensors, stitched alongside the SMA wire, were used to determine the displacement of the fabric and to qualitatively differentiate between the compressive and bending motions demonstrated. In addition, a parametric study was performed to better understand SMA-fabric interactions. Parameters that were studied include elasticity of the fabric base, stitch length, stitch thread elasticity, and programmed coil diameter. Empirical trends for each parameter will be presented in the context of end-to-end displacement and force generation, as well as resulting design guidelines for tailoring robotic fabrics towards various applications. Finally, this discussion will highlight the manufacturability of robotic fabrics that employ thread-like actuators and sensors via common techniques such as sewing and stitching.