

## **Pleats Make Sense: A Study of Knitted Origami Capacitive Sensors for Wearable Motion Recognition**

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### **ABSTRACT**

Textile-based sensors offer remarkable flexibility and ease of integration into clothing. This paper explores the sensing potential of knitted pleated fabric substrates with stitched conductive threads. Three motion-directional pleat patterns—Miura-Ori, Waterbomb, and Huffman Waterbomb—are analyzed as capacitive sensing structures.

Capacitance testing evaluates motion recognition performance under four actions: horizontal stretching, diagonal stretching, compression, and bending. Recognition accuracy is analyzed using a Random Forest classifier based on signal features including energy, peak-to-peak amplitude, and standard deviation. The results reveal a strong correlation between structural topology and classification accuracy. The Waterbomb configuration achieved the highest overall performance, reaching 93.94% accuracy. The Miura-Ori structure demonstrated stable and continuous strain responses suitable for motion tracking, while the Huffman Waterbomb exhibited bistable characteristics that enhance detection of compression events. The principal contribution of this study lies in validating the differing motion-fitting accuracy of pleated textile structures under single-sided and double-sided conductive configurations, providing insights for wearable motion sensing using knitted origami-based capacitive textiles.