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OHSU Research Week 2024

Noninvasive Acute Compartment Syndrome Diagnosis Using Random Forest Machine Learning

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Keywords

orthopedics, compartment syndrome, noninvasive, flexible pressure sensors, machine learning (ML)

Abstract

Acute compartment syndrome (ACS) is an orthopedic emergency caused by elevated pressure within a muscle compartment that can lead to permanent tissue damage and death. Current ACS diagnosis relies heavily on patient-reported symptoms, a method that is subjective and often followed by invasive intracompartmental pressure measurements that can be faulty in motion settings. Reliable motion diagnosis is critical for long-term monitoring that involves limb movement. This study proposes an objective and noninvasive diagnostic for ACS. Our device utilizes a random forest machine learning model that uses analog readings from force-sensitive resistors (FSRs) placed on the skin. To validate the machine learning diagnostic model, a data set containing FSR measurements and the corresponding simulated pressure was created for motion and motionless scenarios. Our diagnostic achieved up to 98% accuracy and excelled in key performance metrics, including sensitivity (97%) and specificity (98%), with a statistically insignificant (±5% error bars) performance difference in motion present cases. These results demonstrate the potential of noninvasive ACS diagnostics to meet clinical accuracy standards in real world scenarios.