

## WEEKLY RESEARCH SEMINAR PRESENTATION

### IMU-Based Urination Window Identification Using a Hybrid Machine Learning Framework: Toward Continuous Bladder Volume Monitoring for SCI Patients



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#### ABSTRACT

Recent innovations in urology leverage bladder volume estimation to support interventions for conditions such as urinary incontinence and neurogenic bladder. These approaches aim to alert users before urination to prevent incontinence and potentially life-threatening autonomic dysreflexia (AD) in spinal cord injury (SCI) patients. The UroPatch (UP) is a wearable device capable of tracking bladder volume during emptying and detecting bladder fullness, enabling potential use in uroflowmetry analysis. However, the device cannot currently detect the urination window—the period during which voiding occurs.

This thesis proposes a two-stage pipeline to identify the urination window using Inertial Measurement Unit (IMU) data embedded in the UP. Sixteen participants performed urination activities while wearing the device, with ground-truth boundaries obtained from a home uroflowmeter. Using a Human Activity Recognition (HAR) framework, Decision Tree, Random Forest, and XGBoost classifiers were evaluated. Due to poor performance in direct three-class classification, a two-stage pipeline combined binary classification with a Hidden Markov Model (HMM) to isolate the urination window.

The proposed method achieved over 80% accuracy, outperforming the direct HAR approach. Results demonstrate the potential of wearable sensors for detecting urination activity and improving urination boundary identification.



**SCAN ME**

**20** March  
2026 *10:30 AM - Kigali,  
Rwanda Time*

**MODE:**  
*Virtual*

**Venue:**  
*UR, College of Science and Technology*

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