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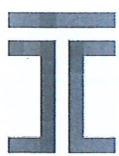
Department of Electrical
Engineering and Computer
Engineering and Informatics

Bachelor Thesis

**Enhancing Pedestrian Dead Reckoning Systems
for Accurate Location Tracking in GNSS-Deprived
and Challenging Environments Using Smartphone
IMU Sensors**

Antonis Christoforou

Limassol, May 2025



Τεχνολογικό
Πανεπιστήμιο
Κύπρου

ΤΜΗΜΑ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ
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Τίτλος: Enhancing Pedestrian recognition systems for accurate location/tracking in GNSS-denied and challenging environments using smartphone IMU sensors

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The approval of the dissertation by the Department of Electrical Engineering, Computer Engineering, and Informatics does not necessarily imply the approval by the Department of the views of the writer.

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ABSTRACT

Pedestrian dead reckoning (PDR) uses smartphone inertial sensors (accelerometer, gyroscope, magnetometer) to estimate displacement by detecting steps and heading changes. However, IMU-based PDR suffers from drift due to sensor biases and magnetic disturbances. This thesis proposes an enhanced PDR framework using real SensorLog data for indoor environments. We implement robust step detection and heading estimation, analyzing metrics such as step cadence, walking speed, path straightness, stop time, and angular velocity to characterize pedestrian motion. Trajectories are visualized via a Python tool that plots classic and color-coded paths. We fuse WiFi fingerprinting (RSSI) with the PDR estimates using a Kalman filter to mitigate drift. This hybrid approach follows prior work, where quaternion-based EKF reduced PDR error to 2.2 m over a 270 m walk, and advanced heading fusion achieved 80

Keywords: Indoor localization; Pedestrian dead reckoning; Smartphone IMU; WiFi fingerprinting; Kalman filter.