Cyprus University of Technology
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

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Τίτλος: Enhancing Pedestrian reckoning systems for accurate location/track in GNSS-denied and challenging environments using smartphone IMU sensors

Επιβλέπων Καθηγητής:

Μιχάλης Μιχαηλίδης		30/05/2025
Όνομα	Υπογραφή	Ημερ.

Εξεταστής 1:

Ηρόδοτος Θεοδοσίου		30/05/2025
Όνομα	Υπογραφή	Ημερ.

Εξεταστής 2:

Χρίστος Λοΐζου		30/05/2025
Όνομα	Υπογραφή	Ημερ.

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Advisor:

Dr. Michalis Michaelides

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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.