

EECE 5554 Lab 4: Understanding Dead Reckoning

This report outlines the analysis of IMU data collected during the dead reckoning lab. The experiments involved collecting IMU data for both circular and square walking paths. The data analysis focuses on the magnetic field, gyroscope, accelerometer, and derived values like velocity and displacement. The findings emphasize the challenges in dead reckoning due to inherent IMU sensor noise and drift.

Circle Dataset Analysis

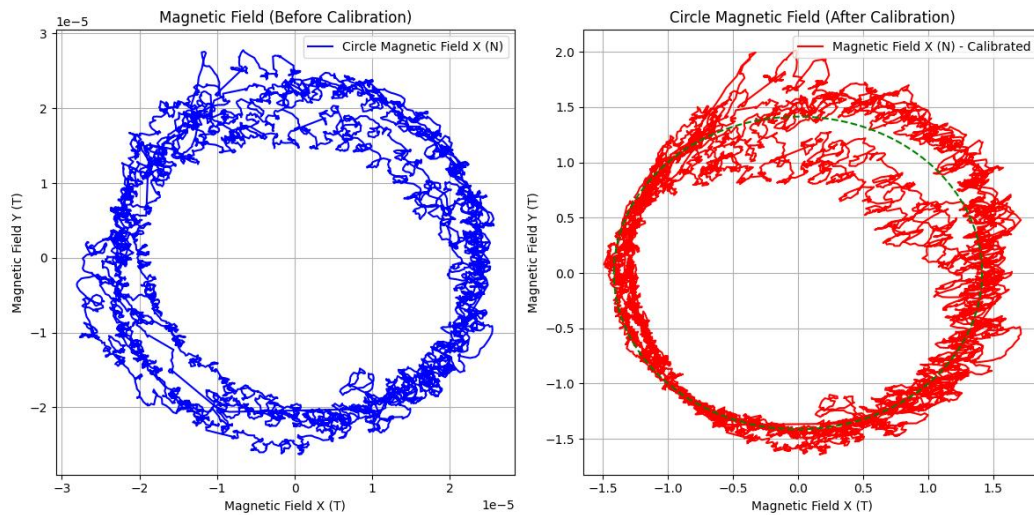


Figure: Circle Dataset - Magnetic Field (Before and After Calibration)

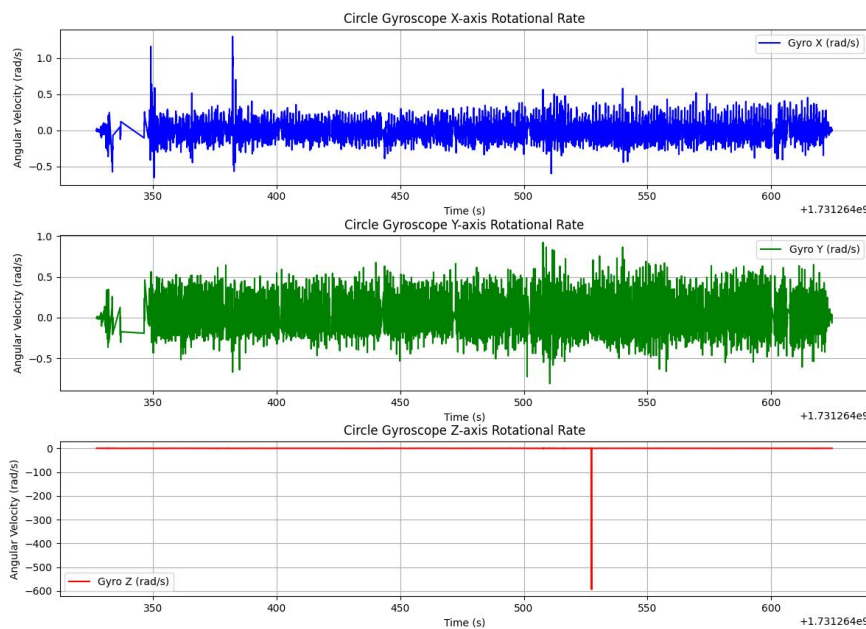


Figure: Circle Dataset - Gyroscope Data (Angular Velocity)

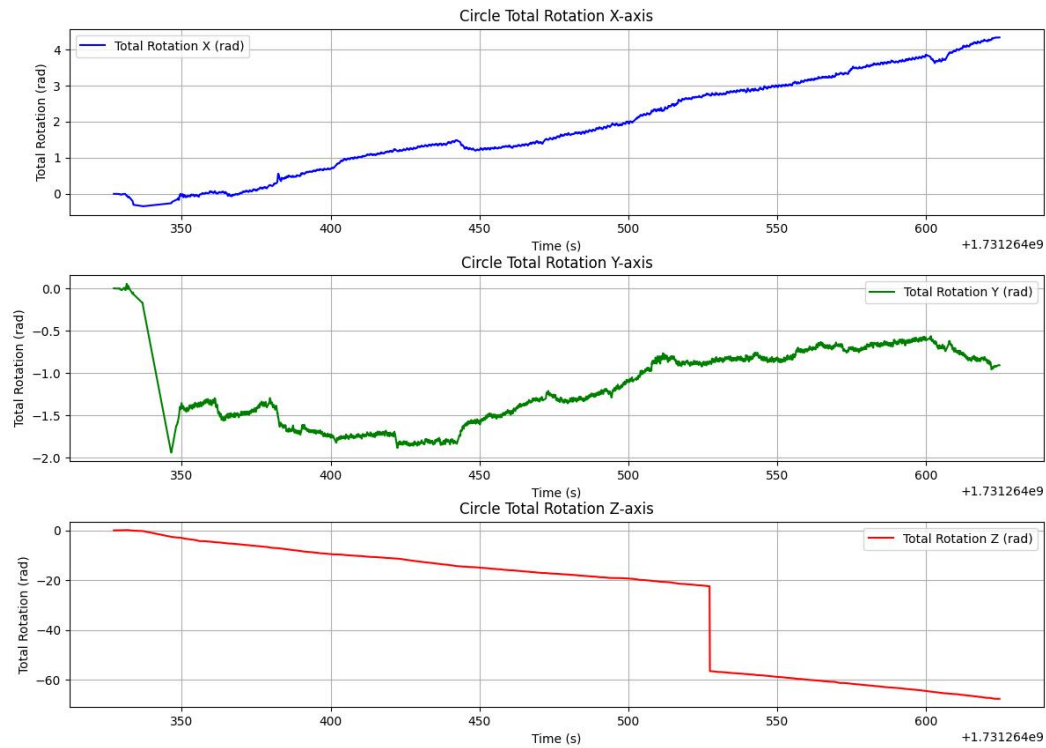


Figure: Circle Dataset - Total Rotation Derived from Gyroscope Data

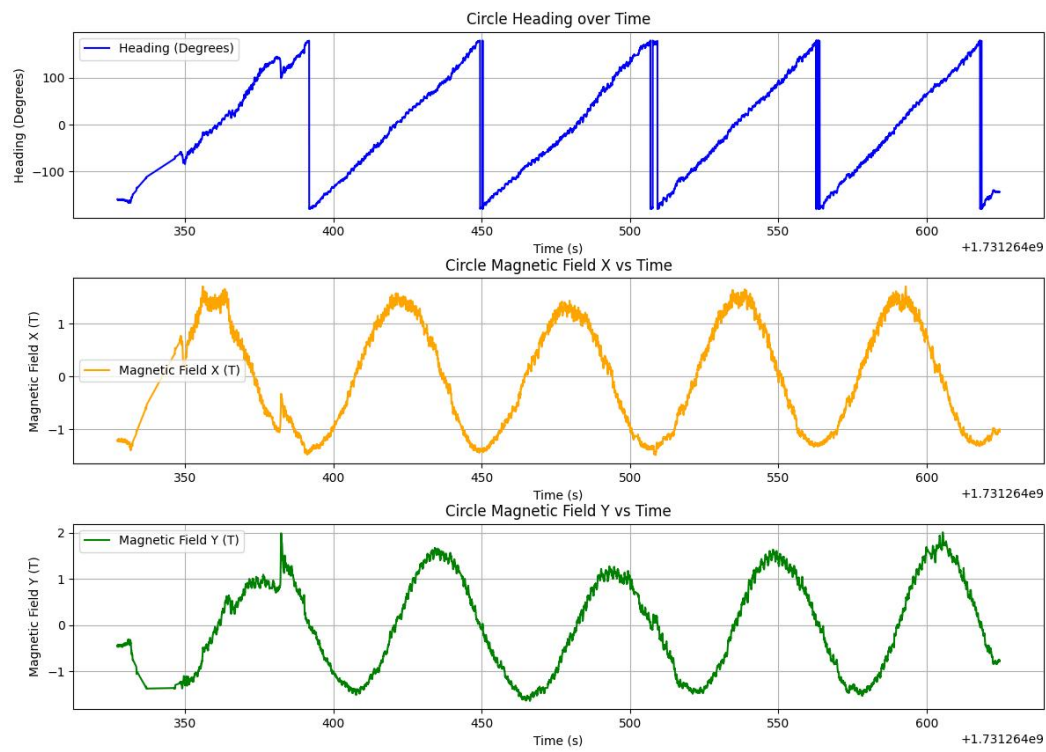


Figure: Circle Dataset - Heading and Magnetic Field Over Time

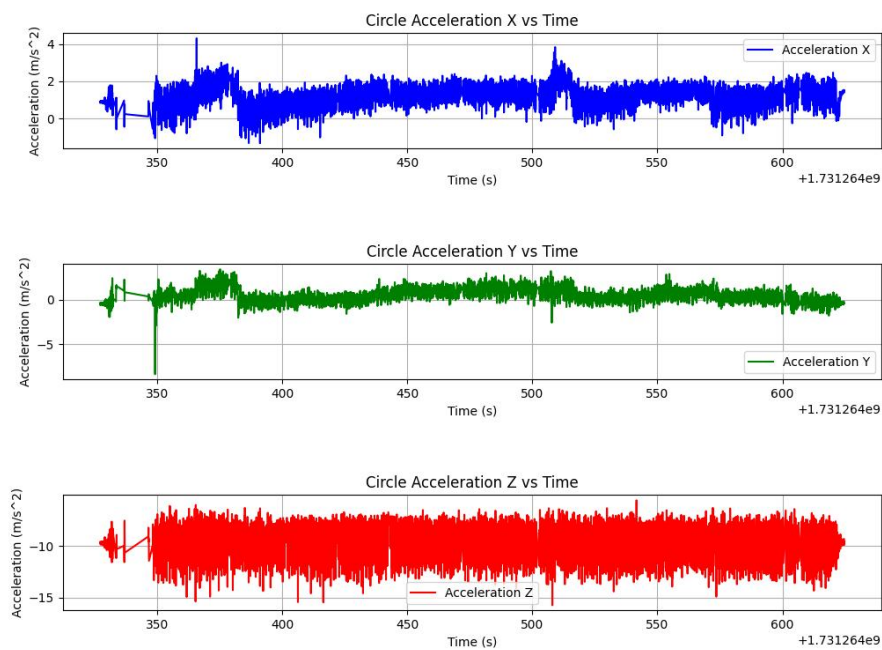


Figure: Circle Dataset - Acceleration Data

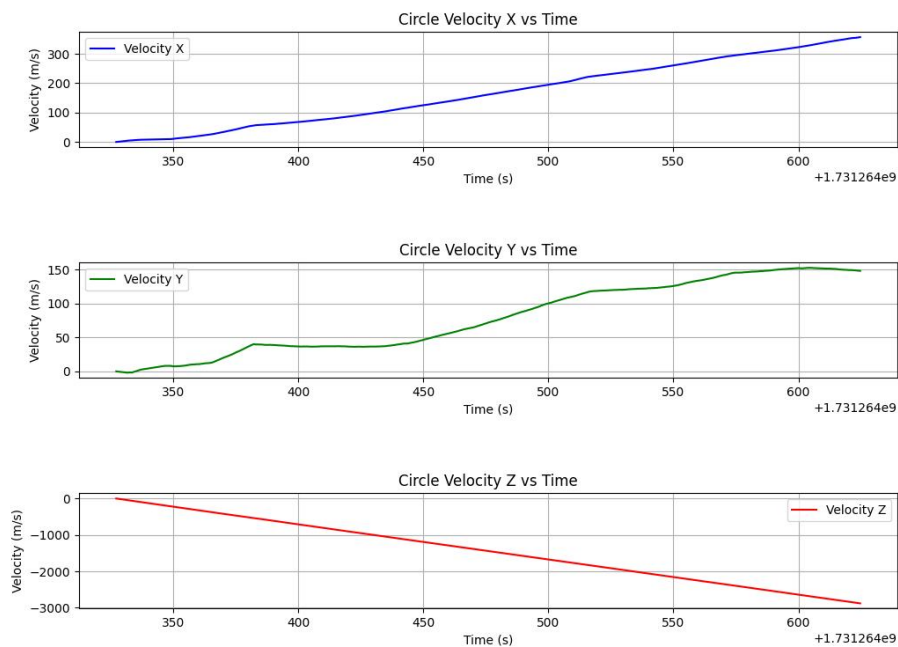


Figure: Circle Dataset - Velocity Derived from Acceleration

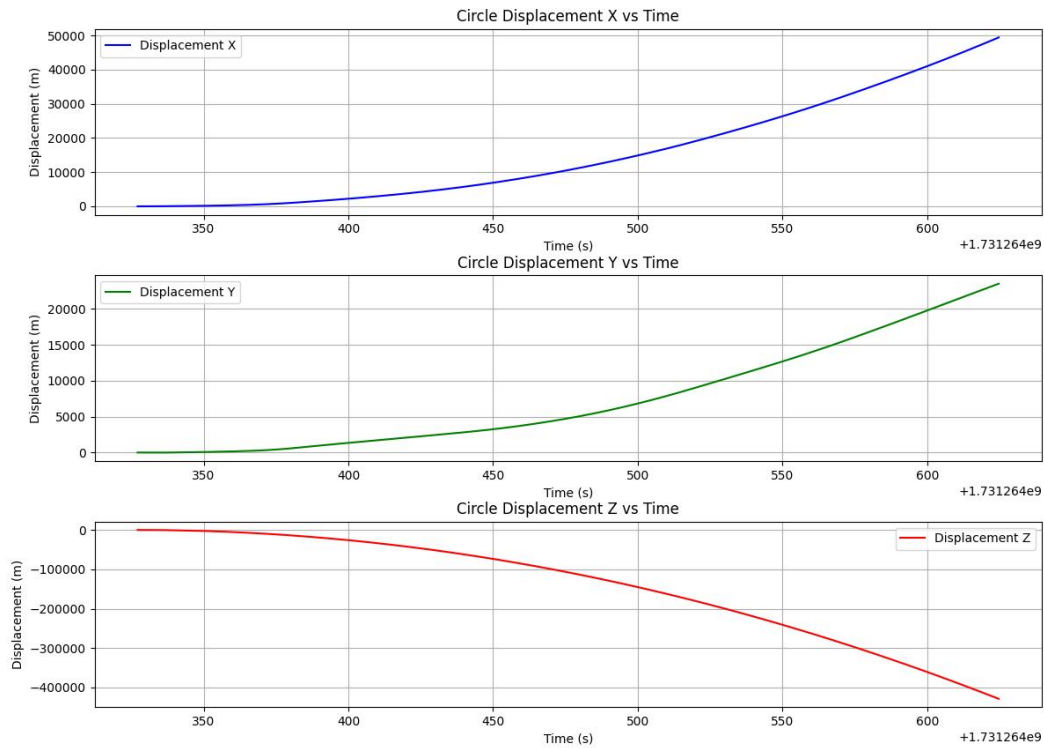


Figure: Circle Dataset - Displacement Derived from Acceleration

The circle dataset analysis demonstrates the effectiveness of calibration in reducing bias in the magnetic field data. The gyroscope data highlights angular velocity variations, and subsequent integrations provide insights into total rotation. Acceleration data reflects walking dynamics, while derived velocity and displacement show trends consistent with circular motion.

Square Dataset Analysis

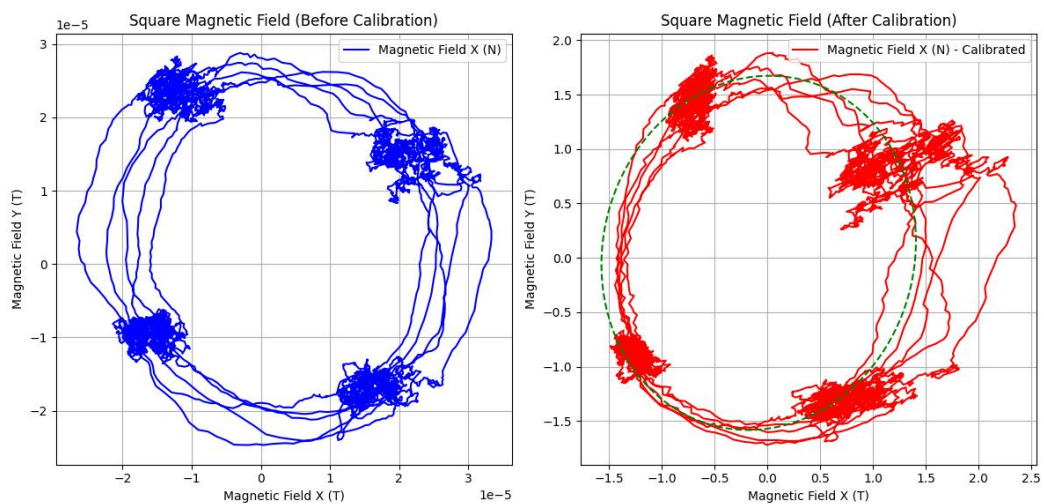


Figure: Square Dataset - Magnetic Field (Before and After Calibration)

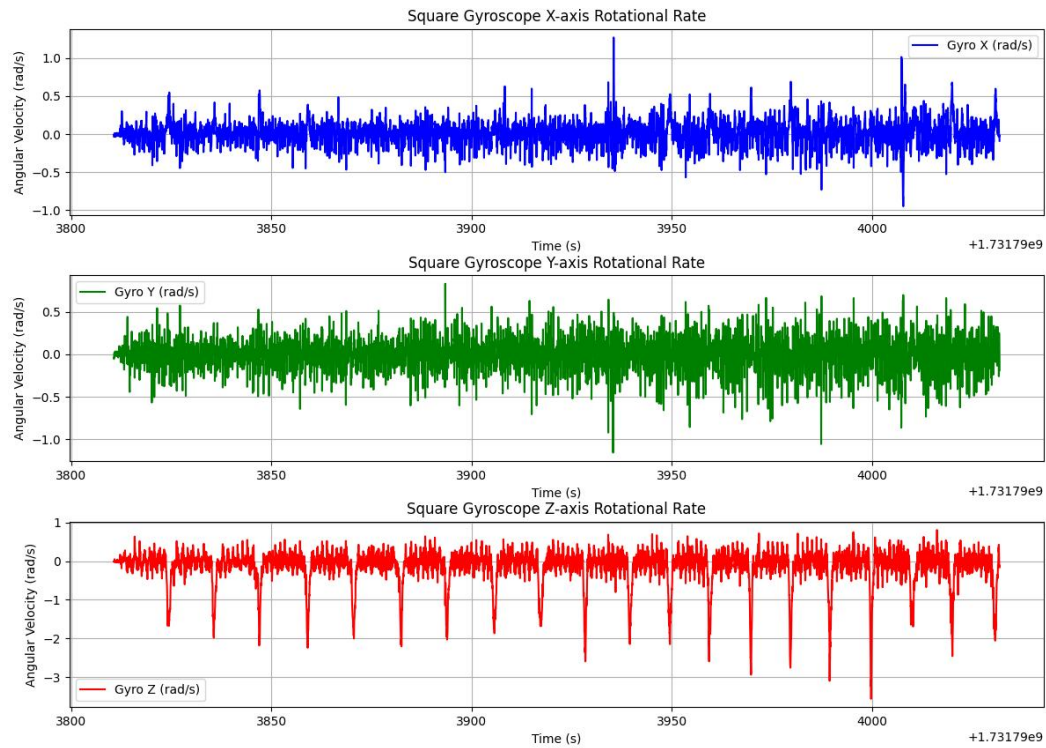


Figure: Square Dataset - Gyroscope Data (Angular Velocity)

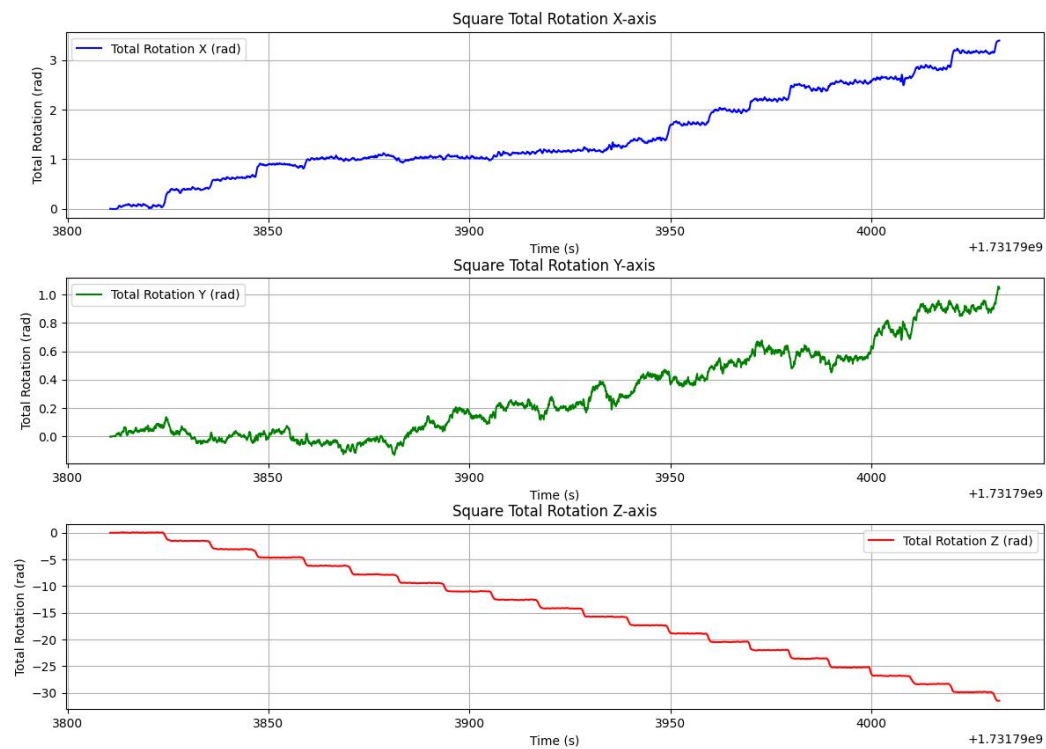


Figure: Square Dataset - Total Rotation Derived from Gyroscope Data

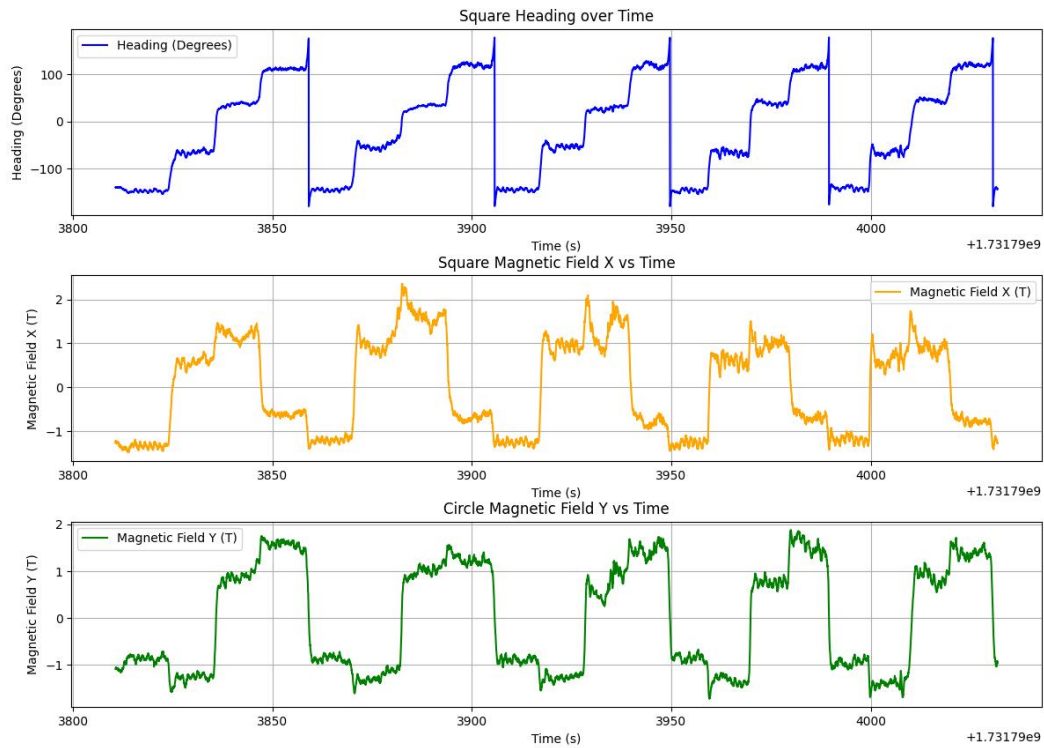


Figure: Square Dataset - Heading and Magnetic Field Over Time

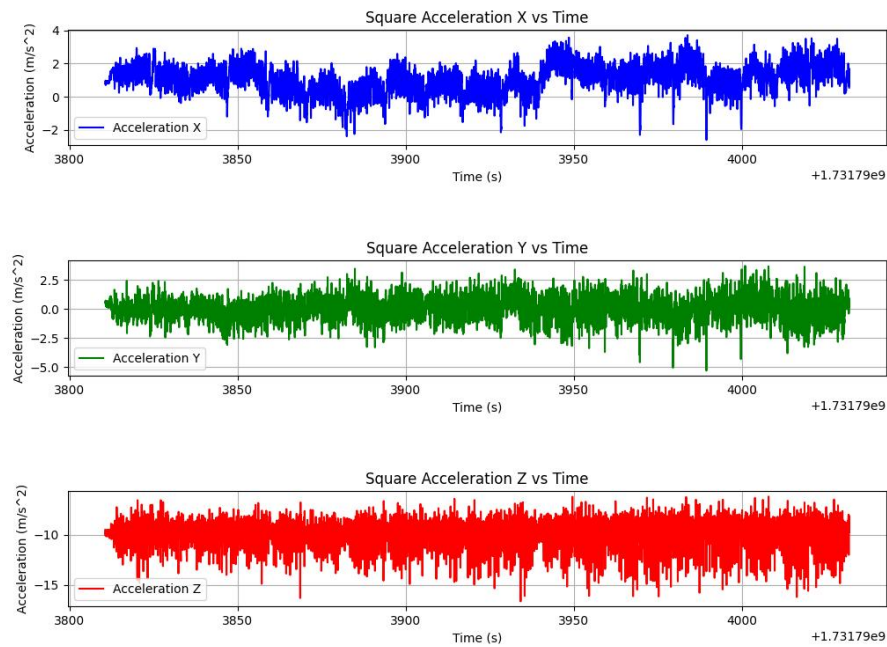


Figure: Square Dataset - Acceleration Data

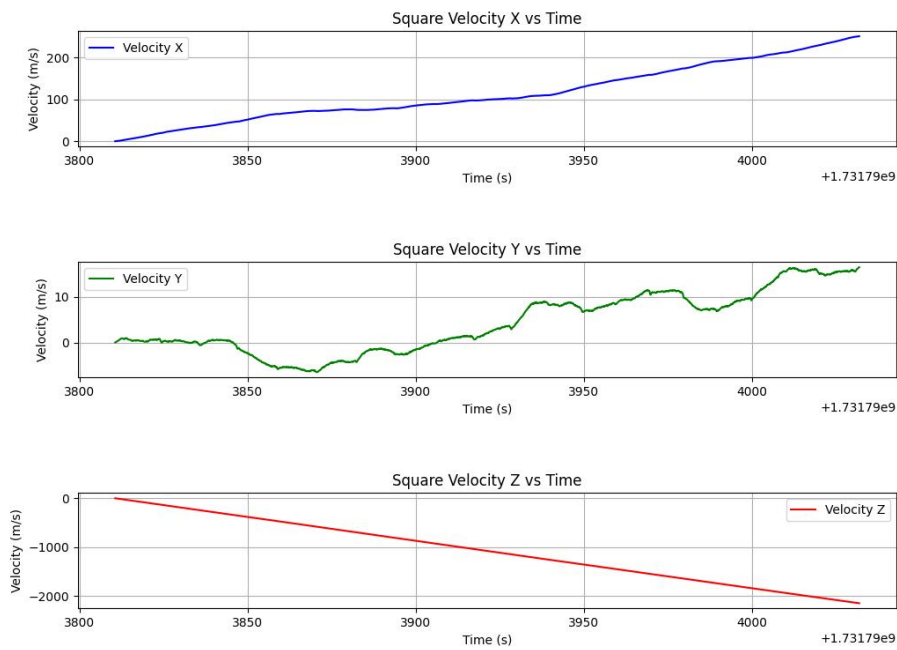


Figure: Square Dataset - Velocity Derived from Acceleration

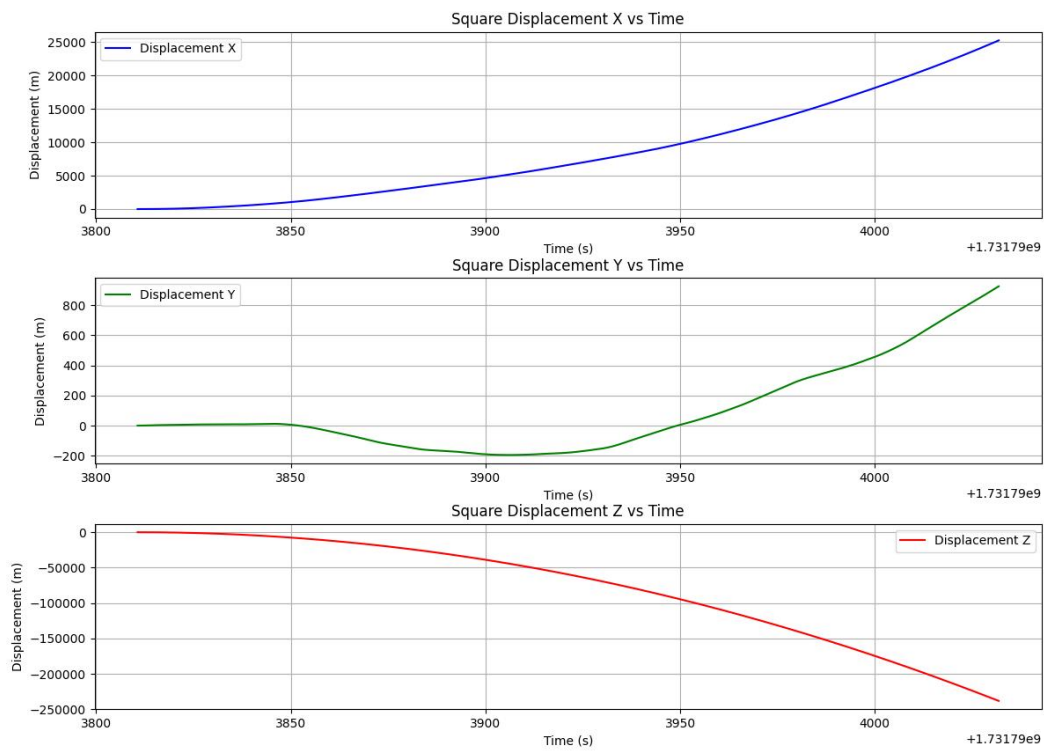


Figure: Square Dataset - Displacement Derived from Acceleration

Question 1:

The square dataset analysis reveals the challenges in accurately capturing sharp turns with IMU data. The magnetic field data shows improved accuracy post-calibration. Gyroscope data provides rotational insights, while acceleration data reflects the stop-and-turn nature of square path walking. Derived velocity and displacement further illustrate the limitations of dead reckoning when the motion involves abrupt changes in direction.

Conclusions**Question 2:**

The experiments with circle and square paths highlight the strengths and weaknesses of dead reckoning using IMU data. Calibration significantly improves magnetic field measurements, but noise and drift in gyroscope and accelerometer data remain challenges. Future experiments should consider advanced filtering techniques to mitigate these effects. Additionally, the design of the IMU holder should ensure consistent sensor alignment to reduce noise during data collection.