

Student Assistant / Thesis

Applying Sensor Fusion Techniques to Smartphone Data for Determining Cyclist Acceleration

Problem Statement

As smartphones have become ubiquitous in our daily lives, their potential as data collection devices has grown immensely, especially considering their various built-in sensors. In the “Harmonizing Mobility (HarMobi) [1]” project, we aim to harness this potential to measure the longitudinal and lateral acceleration of cyclists.

Since the coordinate system of a smartphone (see Fig. 1) is different from the coordinate system of a bike (see Fig. 2), a translation of the acceleration readings is necessary to obtain the longitudinal and lateral acceleration of a cyclist. For this purpose, the orientation of the smartphone should be determined, for which an already implemented algorithm will be handy. Aiming for a more accurate estimation, the smartphone will be fixed to the bike’s steering gear, as illustrated on the left side of Fig. 3.

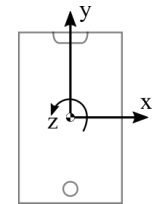


Fig. 1: Smartphone coordinate system

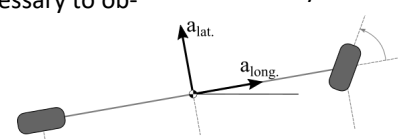


Fig. 2: Bike coordinate system

For better results, GPS data could be fused with the longitudinal and lateral acceleration data to correct them. The entire methodology is illustrated in Fig. 3, where *phyphox* [2] is a free app used for exporting sensor readings.

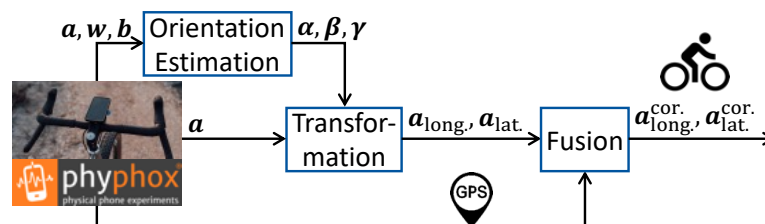


Fig. 3: Overview. \mathbf{a} , \mathbf{w} and \mathbf{b} are raw readings from the accelerometer, gyroscope, and magnetometer of the smartphone, respectively. α , β and γ are the orientation of the smartphone, respectively.

Your Tasks

- ▶ Evaluate the efficacy of the existing orientation estimation algorithm
- ▶ Transform the accelerometer readings from the smartphone coordinate system to the bike coordinate system
- ▶ Develop a sensor fusion technique to correct the longitudinal and lateral acceleration with GPS data
- ▶ Evaluate the accuracy of the corrected longitudinal and lateral acceleration data

Your Profile

- ▶ Experience in programming is required
- ▶ Experience/knowledge in fusion techniques is advantageous
- ▶ Familiarity with MATLAB is a plus
- ▶ Affinity to mathematics is a plus

Contact

Please read our [Instructions for Applications](#).

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[1] https://www.embedded.rwth-aachen.de/doku.php?id=en:forschung:mobility#harmonizing_mobility_funded_by_the_bmdv

[2] <https://phyphox.org>