# Adaptive Driving Event Detection Algorithm using Smartphone Sensor Data

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*Abstract*—**Harsh driving is one of the major causes for traffic accidents. Based on the quantified-self trend, the growing willingness of many people to collect data about themselves, their behavior and their environment, a few applications already exist which analyze the driver behavior with a focus on harsh driving. However, algorithms often rely on battery-consuming GPS data. This work presents a novel rotation algorithm which contributes to the preservation of battery life.**

According to a report on CNN more than one million people died worldwide through traffic accidents in 2016 [1]. Although authorities are trying to reduce these numbers by legislating for certain risk factors, the number of deaths is still comparatively high. For instance, one study investigated police reports of traffic accidents in the UK and found out, that a dangerous driving style (reckless driving, excessive speed) is one of the major causes for traffic accidents [2].

This study aims to present the current status of an ongoing work about an adaptive algorithm to detect harsh driving events (e.g. hard braking, hard accelerating, driving too fast over a pothole or speedbump) given a recorded dataset of smartphone sensor data during driving. The algorithm can be used to provide feedback to drivers, who are interested in analyzing their own driving style. To increase the acceptance of the solution, the smartphone is not required to be in the same location all the time and can be moved during recording (adaptive algorithm). Many adaptive reorientation algorithms have a strong reliance on GPS data, although the GPS sensor is consuming a lot of battery power. To preserve battery lifetime, our algorithm avoids steps of the algorithm relying on GPS whenever possible. According to [3], the acceptance may also suffer if the recordings are processed external (e.g.: server). Therefore, the resulting algorithm will be analyzed if it can be adjusted to run in real time.

The algorithm uses the measurements from accelerometer, gyroscope, magnetometer (the so-called inertial measurement unit – IMU), and GPS sensor. First the algorithm rotates the data to align it with the reference frame of the vehicle. This is done by detecting segments of same orientation and then finding the Euler angles (pitch, roll, yaw) for the rotation based on the recorded data. Given the measurements from the reference frame of the vehicle, experimentally obtained thresholds and patterns for harsh events will be used to detect them. Figure 1 shows forward acceleration (x-direction) measurements from two devices. The reference device (grey color) was mounted in the vehicle perfectly aligned with the vehicle. The second device was simply placed somewhere in the vehicle, and the data was rotated using the proposed algorithm. Thereby, the algorithms used magnetometer measurements and GPS data for calculating the yaw angle, the gyroscope for instance to detect curves, and the GPS data to fine-tune the results. Figure 2 illustrates that the algorithm produces promising results also for lateral acceleration (y-direction) measurements. To evaluate the algorithm, combinations of three cars and two smartphones were tested, yet.

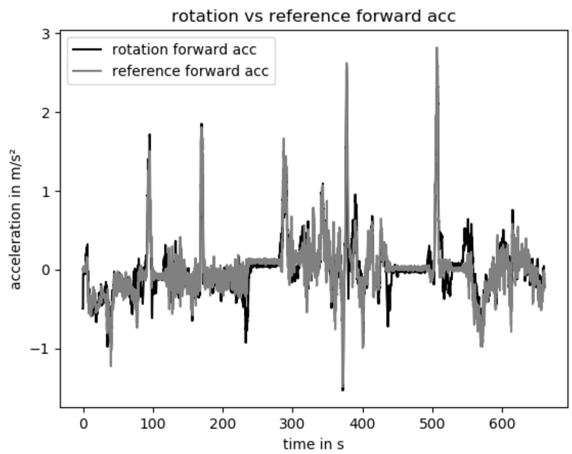


Fig. 1. An example of the rotation algorithm for forward acceleration (x-direction).

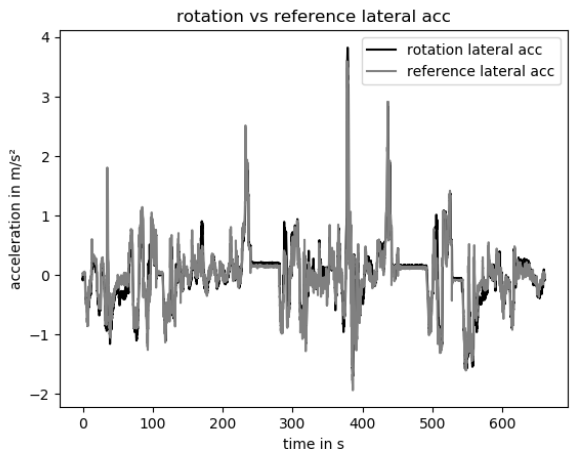


Fig. 2. An example of the rotation algorithm for lateral acceleration (y-direction).

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