**B07 (Invisible Sensing of Vehicle Steering with Smartphones)**

In 2012, a total of 30.8% of fatal road accidents resulted from drivers’ careless or erroneous steering. Most existing solutions that detect dangerous steering are constrained by the high-visibility requirement of vision-based sensing. V-Sense allows for an inexpensive, and potentially more effective solution to detecting and avoiding dangerous steering using non-vision sensors on commodity smartphones. Because V-Sense relies on non-vision sensors, the problem of differentiating various steering patterns arises. The authors use a bump detection algorithm, utilizing the number and shape of bumps from on-board yaw rate readings, and horizontal displacement to differentiate steering maneuvers. From a total of 40 hours of test driving in different environments, V-Sense achieved: 100% accuracy in detecting both right and left turns, regardless of phone placement and road condition, and over 90% accuracy in detecting lane changes/curvy roads, when the phone is mounted on the windshield.

**B10 (Driver Identification Using Automobile Sensor Data from a Single Turn)**

Using the ubiquity of sensors, vehicles can utilize sensor data taken from a single turn to build profiles for individual drivers - allowing for a bespoke driving experience for each person. Sensor data can also detect changes in driver behavior during a drive, perhaps when a person picks up a phone and gets distracted, and respond accordingly in order to make sure the driver remains safe. The challenge is differentiating drivers making similar turns. The authors use a classification algorithm applied to 12 different microscopic sensor readings to create a set of data matrices. To predict each driver, a Random Forest classifier is used to identify the driver using a series of decision trees. For evaluation, 12 common turns in the data are examined independently without incorporating any information from each other. Taking a balanced training set, the authors evaluated prediction accuracy for different turns and different numbers of drivers. For a two-driver classification, the prediction is correct, on average, 76.9% of the time, whereas the prediction rate drops to an average of 50.1% for five drivers.

**B11 (Mobile IMUs Reveal Driver’s Identity From Vehicle Turns)**

Due to the increasing abundance of accessible vehicular data, drivers are increasingly vulnerable to privacy invasion/leakage. The paper highlights an example of adversarial attack called Dri-Fi, which fingerprints the driver within only one vehicle turn using IMU sensor measurements. Similar to V-Sense, Dri-Fi addresses the problem of differentiating various steering patterns using “bumps” in gyroscopic data. This data is then put into a machine classifier (e.g. Random Forest) to fingerprint a specific driver. To evaluate accuracy, the authors had to make sure that results are dependent only on the driver and remain constant with various changing factors (e.g. cars/routes). To do so, the authors collected data from 10 cars of 7 different models, and routes were freely chosen by drivers. The results implied that if the driver is identical in multiple trials, Dri-Fi gets confused (~50% accuracy), whereas if different drivers were used, the accuracy rate rises to 90-100% correct.

**B17 (PupilScreen: Using Smartphones to Assess Traumatic Brain Injury)**

Traumatic brain injury (TBI) accounts for 30% of all injury-related deaths in the U.S., so a quick and effective way of assessing a TBI is crucial to help save lives. Because the gold standard for assessing a person’s pupillary light reflex (PLR) costs ~$4500, a more accessible solution is needed. PupilScreen utilizes a 3D printed box and a smartphone to combine the repeatability, accuracy, and precision of a clinical device at a fraction of the cost. The main challenges are: 1) designing a controlled setup that is portable and inexpensive, and 2) accurately identifying the pupils in video using only video light. The 3D printed box design allows for relatively inexpensive durability, but can be substituted with an even cheaper material like cardboard, and convolutional neural networks were used to provide accurate pupillometry. PupilScreen’s pilot clinical evaluations could achieve a median error of 0.30 mm while measuring pupil diameter, and was able to identify six patients with a TBI with almost perfect accuracy.

The “Mobile Sensing” area opened my eyes to the endless applications of the countless sensors we can employ to help improve quality of life. Its inspired me to be more imaginative and pushed me to think about some big problems that can potentially be solved by using mobile sensors.