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(57) Abstract:

This project investigates the cyber-security problem for autonomous vehicles under sensor attacks. In particular, a model-based framework is proposed which can detect sensor attacks and identify their sources in order to achieve the secure localization of self-driving vehicles. To ensure robustness of the vehicle against cyber-attacks, sensor redundancy is introduced, that is to deploy multiple sensors, each of which provides real-time pose observations of the vehicle. A bank of attack detectors is developed to capture anomalies in each sensor measurement, which is a combination of an extended Kalman filter (EKF) and a cumulative sum (CUSUM) discriminator. EKFs are employed to estimate the vehicle position and orientation recursively, while each CUSUM discriminator is designed to analyze the residual generated by its combined EKF to detect the possible deviation of the sensor measurement from the expected pose derived according to the mathematical model of the vehicle. To monitor the inconsistency amongst multiple sensor measurements, an auxiliary detector is introduced which fuses observations from multiple sensors. Based on the results of all the detectors, a rule-based isolation scheme is developed to identify the source anomalous sensor. The effectiveness of our proposed framework has been demonstrated on real vehicle data.

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