EVTwinCyb: Evaluating Resilient State Estimation Techniques and Mitigation Strategies for Electric Vehicle Digital Twin Systems Aga inst FDI and DoS Cyber Threats

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Abstract—: Electric Vehicle (EV) systems are becoming significantly more and more integrated with the advanced algorithms required for navigation, sensors, actuators, cameras, safety, and energy management systems. However, these real-time systems are vulnerable to cybersecurity threats, which can significantly compromise their performance, privacy, and security risk. One of the key limitations of present EV systems is their vulnerability to key cyberattacks, which can disrupt navigation and control, potentially leading to accidents, risk, reduced efficiency, and compromised safety. This work addresses this limitation by using simulation to model EV digital twin systems under attack and assessing the performance of the proposed algorithms in terms of EV state estimation accuracy, safety, and efficiency. The main contributions of this task include a detailed analysis of the impact of False Data Injection (FDA) and Denial of Service (DoS) attacks on EV systems, as well as the evaluation of three robust algorithms in detecting and mitigating these attacks. The simulation results demonstrate that the Extended Kalman Filter, and Unscented KF, methods can enhance the resilience of EV systems compared with the Particle Filter. This research and findings have significant implications for both the academic community and industry, providing valuable insights into cybersecurity challenges in real time EVs.

Keyword—Electric Vehicle, False Data Injection, Denial of Service, State Estimation Algorithms

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