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Sensor and Actuator Fault Detection in Connected Vehicles under a Packet Dropping Network

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Abstract : Connected vehicles are one of the promising technologies for future Intelligent Transportation Systems (ITS). A connected vehicle system is essentially a set of vehicles communicating through a network to exchange their information with each other and the infrastructure. Although this interconnection of the vehicles can be potentially beneficial in creating an efficient, sustainable, and green transportation system, a set of safety and reliability challenges come out with this technology. The first challenge arises from the information loss due to unreliable communication network which affects the control/management system of the individual vehicles and the overall system. Such scenario may lead to degraded or even unsafe operation which could be potentially catastrophic. Secondly, faulty sensors and actuators can affect the individual vehicle’s safe operation and in turn will create a potentially unsafe node in the vehicular network. Further, sending that faulty sensor information to other vehicles and failure in actuators may significantly affect the safe operation of the overall vehicular network. Therefore, it is of utmost importance to take these issues into consideration while designing the control/management algorithms of the individual vehicles as a part of connected vehicle system. In this paper, we consider a connected vehicle system under Co-operative Adaptive Cruise Control (CACC) and propose a fault diagnosis scheme that deals with these aforementioned challenges. Specifically, the conventional CACC algorithm is modified by adding a Kalman filter-based estimation algorithm to suppress the effect of lost information under unreliable network. Further, a sliding mode observer-based algorithm is used to improve the sensor reliability under faults. The effectiveness of the overall diagnostic scheme is verified via simulation studies.

Keywords : fault diagnostics, communication network, connected vehicles, packet drop out, platoon
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