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Diversity for Safety and Security of Autonomous Vehicles against Accidental and Deliberate Faults

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Abstract : Safety and security of autonomous vehicles (AVs) is a growing concern, first, due to the increased number of safety-critical functions taken over by automotive embedded systems; second, due to the increased exposure of the software-intensive systems to potential attackers; third, due to dynamic interaction in an uncertain and unknown environment at runtime which results in changed functional and non-functional properties of the system. Frequently occurring environmental uncertainties, random component failures, and compromise security of the AVs might result in hazardous events, sometimes even in an accident, if left undetected. Beyond these technical issues, we argue that the safety and security of AVs against accidental and deliberate faults are poorly understood and rarely implemented. One possible way to overcome this is through a well-known diversity approach. As an effective approach to increase safety and security, diversity has been widely used in the aviation, railway, and aerospace industries. Thus, the paper proposes fault-tolerance by diversity model takes into consideration the mitigation of accidental and deliberate faults by application of structure and variant redundancy. The model can be used to design the AVs with various types of diversity in hardware and software-based multi-version system. The paper evaluates the presented approach by employing an example from adaptive cruise control, followed by discussing the case study with initial findings.

Keywords : autonomous vehicles, diversity, fault-tolerance, adaptive cruise control, safety, security
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