MOUNTAIN-PLAINS CONSORTIUM

PROJECT BRIEF | March 2015

Position Verification Systems for an Automated Highway System

the ISSUE

To increase the throughput, efficiency, and safety of transportation systems, researchers have proposed that the system be automated. A vehicle that provides false information would be able to slow down groups of vehicles. Therefore, it is imperative that each vehicle's position, velocity and acceleration in an automated system be substantiated.

the RESEARCH

Automated vehicles promote road safety, fuel efficiency, and reduce travel time, by decreasing traffic congestion and driver workload. In a vehicle platoon (grouping vehicles to increase road capacity by managing distance between vehicles using electrical and mechanical coupling), as in automated highway systems (AHS), tracking of inter-vehicular spacing is one of the significant factors under consideration. Because of close spacing, computer-controlled platoons with inter-vehicular communication—the concept of adaptive cruise control (ACC)—become open to cybersecurity attacks.

Cyberphysical (CP) and cyber attacks on smart grid electrical systems have been a significant focus of researchers. However, CP attacks on autonomous vehicle platoons have not been examined. This

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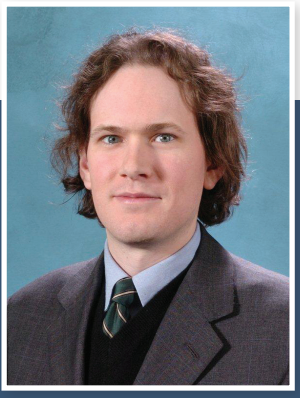

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Project Title

Position Verification Systems for an Automated Highway System

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the RESEARCH (cont.)

research surveys a number of models of longitudinal vehicle motion and analysis of a special class of CP attacks called false data injection (FDI) on vehicle platoons. In this kind of attack, the configuration of any CP system is exploited to introduce arbitrary errors to gain control over the system. Here, an n-vehicle platoon is considered and a linearized vehicle model is used as a testbed to study vehicle dynamics and control, after false information is fed into the system.

the FINDINGS

Various vehicle models particularly designed for longitudinal motion were analyzed as to their viable usage in different research relevant to longitudinal motion control. And, then, using a simple linearized vehicle model as a proving ground, analysis of scenarios where varied false data was injected into the system, was done. It has been seen, so far, that the attacks were able to make the system string unstable as the vehicles cross paths considerably before they reach a state of stability, when the attacker has access to information on the vehicles that are immediately following or preceding it. The attacker is capable of gaining control over the positions and velocities of the platoon, in one way or the other.

the IMPACT

Cyber-physical systems (CPS) are systems that comprise computational elements to communicate among and control physical entities. A platoon of autonomous vehicles is one such system. Owing to such computer control, the system becomes susceptible to various kinds of cyber-physical attacks. This research entails the survey of a number of vehicle models used in different works pertaining to longitudinal motion and analysis of a special class of cyber-physical attacks called False Data Injection (FDI) attacks on vehicle platoons moving with longitudinal motion. This research shows that the attacker is capable of gaining control and additional security works is required.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=794

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.