

CAREER: High Integrity Navigation for Autonomous Vehicles

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Project Details

Lead PI:	Grace Gao
Performance Period:	05/15/18 - 04/30/23
Institution(s):	University of Illinois at Urbana-Champaign
Sponsor(s):	National Science Foundation
Award Number:	1750864

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Abstract: The number of systems developed for applications including package delivery via small unmanned aerial vehicles (UAVs) and self-driving cars, is growing. To ensure safe and reliable positioning, it is critical to address not only positioning accuracy, but also the confidence in accuracy, defined as integrity. Most of the positioning and navigation studies for autonomous vehicles have focused on only accuracy, but not integrity. However, navigating autonomous vehicles equipped with relatively low-cost sensors in complex and rapidly changing environments -- e.g., urban areas with Global Positioning System (GPS) signal blockage -- poses great challenges compared to flying aircraft in the open sky, where positioning integrity has been well addressed by the Federal Aviation Administration (FAA)-regulated aviation industry. This project aims to assess, monitor and improve positioning integrity for autonomous vehicles, such as UAVs and self-driving cars, and integrate the proposed research into education and outreach. The project involves a novel positioning integrity assessment and monitoring solution that is robust in GPS-challenged environments and is suitable for navigation sensor fusion. The investigator will (1) derive a new algorithm to directly assess and monitor GPS integrity in urban environments; (2) design an integrity monitoring framework for GPS sensor fusion using camera vision, LiDAR and inertial measurements; and (3) improve integrity by turning unwanted multi-path signals into a useful navigational source based on physical interaction with the environment. This CAREER development plan will also integrate an education plan with the research goals by broadening participation of under-represented groups, such as women, by fostering a female researcher community through organizing female social events at technical conferences; educating and informing the public about FAA rules and safety issues regarding flying UAVs; and outreach to K-12 students by demonstrating the results of the proposed research at the Illinois Engineering Open House and leading hands-on activities for various school girl camps.

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