Graduate Seminar (EEL 6936)
Department of Electrical Engineering
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The University of California, Riverside, CA, USA
Electrical & Computer Engineering

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Resilient and Accurate Navigation for Autonomous Vehicles

Abstract

The steady trend towards autonomous vehicles will come with a demand for full situational awareness and extremely reliable and accurate navigation systems. With no human in the loop, the cost of navigation system failure will be severe. Reliance on GPS for navigation has become a single point of failure. The recent uptick in GPS jamming and spoofing incidents have exposed the vulnerability of GPS-based navigation and demonstrated the necessity for a complementary navigation system. We propose a new navigation framework that we call Collaborative Opportunistic Navigation. In this framework, radios collaboratively draw relevant positioning and timing information from ambient signals of opportunity (SOPs) to build and continuously refine a global signal landscape map of the environment within which they simultaneously localize themselves in space and time. For the sake of motivation, consider the following problem. A number of radios with no a priori knowledge about their own states are dropped in an environment comprising multiple unknown SOPs. The radios draw pseudo range observations from the SOPs. The radios' objective is to build a high-fidelity signal landscape map of the environment within which they localize themselves in space and time. We then ask: (1) What is the minimal required a priori knowledge about the environment for full observability? (2) How should we characterize recently discovered SOPs on-the-fly? (3) How can the fidelity of the signal landscape map and spatio-temporal radio localization accuracy be improved via (i) motion planning and (ii) deployment of multiple radios? (4)What collaborative filtering architecture is best for sharing information among radios?

Biography

Dr. Zak Kassas is an Assistant Professor of Electrical and Computer Engineering at The University of California, Riverside. He received a B.E. in Electrical Engineering from the Lebanese American University, an M.S. in Electrical and Computer Engineering from The Ohio State University, and an M.S.E. in Aerospace Engineering and a Ph.D. in Electrical and Computer Engineering from The University of Texas at Austin. From 2004 through 2010 he was a research and development engineer with the LabVIEW Control Design and Dynamical Systems Simulation Group at National Instruments Corporation. He has published over twenty refereed journal and conference articles, holds a U.S. patent, and is a senior member of the IEEE. His research interests include estimation, navigation, autonomous vehicles, target tracking, and intelligent transportation systems.