No GPS, No Problem: Exploiting Signals of Opportunity for Resilient and Accurate Autonomous Vehicle Navigation

Zak Kassas, Ph.D
Assistant Professor, University of CA, Irvine

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 cyber attacks on GPS (jamming and spoofing) have exposed the vulnerability of GPS-based navigation and demonstrated the necessity for a complementary navigation system.

This talk will present a framework for resilient and accurate autonomous vehicle navigation by exploiting ambient radio frequency signals of opportunity, which are not intended as navigation sources. In this framework, specialized vehicle-mounted radios collaboratively draw relevant positioning and timing information from ambient signals of opportunity to build and continuously refine a spatiotemporal signal landscape map of the environment within which the vehicles simultaneously localize themselves in space and time. We will present an end-to-end research approach, spanning theoretical modeling and analysis of signals of opportunity, specialized software-defined radio (SDR) design, practical navigation algorithm development, and experimental demonstration of our system on ground vehicles and unmanned aerial vehicles (UAVs), navigating with terrestrial and space-based signals of opportunity.