INTER-PANEL INVITED LECTURE #1

Title:
A Look at the Stars: LEO PNT with Non-cooperative Satellites

Abstract:
We are witnessing a space renaissance. Tens of thousands of broadband low Earth orbit (LEO) satellites are expected to be launched by the end of this decade. These planned megaconstellations of LEO satellites along with existing constellations will shower the Earth with a plethora of signals of opportunity, diverse in frequency and direction. These signals could be exploited for positioning, navigation, and timing (PNT) in the inevitable event that global navigation satellite system (GNSS) signals become unavailable (e.g., in deep urban canyons, under dense foliage, during unintentional interference, and intentional jamming) or untrustworthy (e.g., under malicious spoofing attacks).
This lecture will overview the challenges associated with exploiting megaconstellation non-cooperative LEO satellites for PNT purposes, namely their unknown signals, poorly known ephemerides, loose synchronization and oscillator instability, and propagation effects. A framework termed STAN: simultaneous tracking and navigation will be introduced to overcome these challenges. We will present an end-to-end approach, spanning theoretical modeling and analysis, specialized cognitive software-defined radio (SDR) design, practical PNT algorithms, and experimental demonstrations of STAN with multi-constellation LEO satellite signals (Starlink, OneWeb, Orbcomm, Iridium, and NOAA) to an unprecedented level of accuracy on stationary receivers, ground vehicles, unmanned aerial vehicles (UAVs), high altitude platform stations (HAPS), and maritime vehicles. Insights into future research directions and engineering implementation challenges will be provided as concluding remarks.

Bio:

Prof. Zak Kassas is the TRC Endowed Chair of Intelligent Transportation Systems and a Professor of Electrical & Computer Engineering at The Ohio State University. He is also Director of the U.S. Department of Transportation Center for Automated Vehicles Research with Multimodal AssurEd Navigation (CARMEN), focusing on navigation safety and resiliency for highly automated transportation systems. His awards include the Presidential Early Career Award for Scientists and Engineers (PECASE) from President Biden, National Science Foundation CAREER Award, Office of Naval Research Young Investigator Program Award, Air Force Office of Scientific Research Young Investigator Award, IEEE Richard Kershner Award, IEEE Walter Fried Award, IEEE Harry Rowe Mimno Award, ION Burka Award, and ION Thurlow Award. Since starting his academic career in 2014, he has been awarded more than $28 million in competitive grants. He was ranked by ScholarGPS as the top scholar globally in the field of navigation over the past 7 years. He is a Fellow of the IEEE, a Fellow of the ION, and a Distinguished Lecturer of the IEEE Aerospace and Electronic Systems Society.