

Integrated mm-Wave Wireless Positioning – The Future of Urban Navigation



Dr. Aboelmagd Noureldin

NavINST – Navigation and Instrumentation Research Group
Department of Electrical and Computer Engineering
Royal Military College of Canada.

E-mail: nourelda@queensu.ca, Web: <https://www.navinst.ca>



ABSTRACT

As the world continues to move toward a more efficient transportation system driven by connected and autonomous vehicles (CAV), there is a growing demand for new technologies that guarantee efficient and safe operation. Trust in CAVs hinges on the reliability of autonomy, including the crucial task of positioning and navigation, which should be accurately provided at high precision everywhere for all environments and operating conditions. The next-generation mobile networks (5G and 6G) operating in the millimeter wave (mmWave) band is anticipated to transform modern societies by providing an ultra-reliable, high-speed communications infrastructure. mmWave operates with high bandwidth, allowing for high-resolution time-based measurements hence accurate range estimation. It also features massive MIMO antennas, providing higher angular resolution and precise angle-based measurements. The use of mmWave wireless networks for high-precision positioning in CAVs may have the potential to significantly improve the safety and efficiency of transportation systems.

In this presentation, the recent advancements in mmWave wireless networks for high-precision positioning will be explored, with a specific focus on navigating CAVs in densely populated urban areas. The discussion will cover the development and implementation of a seamless positioning solution that integrates the mmWave wireless network with the motion sensors onboard the CAV. Furthermore, the presentation will examine how non-line-of-sight signals can be used for wireless positioning and how to overcome the challenge of multipath in urban environments. The capabilities of achieving an uninterrupted decimeter level of positioning accuracy will be demonstrated, making the developed methods suitable for level three of autonomy. The presentation will showcase the performance of the integrated mmWave wireless positioning solution using road test trajectories from downtown Toronto, Ontario, Canada.

BIO



Dr. Aboelmagd Noureldin is a Professor at the Department of Electrical and Computer Engineering, Royal Military College of Canada (RMC), with Cross-Appointment at the School of Computing and the Department of Electrical and Computer Engineering, Queen's University. He is also the founder and the director of the Navigation and Instrumentation (NavINST) research group at RMC. He has been a leader in the field of inertial navigation, global navigation satellite systems including GPS, wireless location and navigation, intelligent multi-sensor systems with applications related to positioning and navigation of autonomous vehicles and mobile robot systems; machine learning-based human activity recognition and positioning; integrated wireless indoor navigation; intelligent transportation, road information services, crowd management, and vehicular internet of things.

Dr. Noureldin holds a B.Sc. degree in Electrical Engineering (1993) and M.Sc. in Engineering Physics (1997), both from Cairo University, Egypt. In addition, he holds a Ph.D. degree in Electrical and Computer Engineering (2002) from the University of Calgary, Alberta, Canada. Dr. Noureldin is a Senior member of the IEEE and a professional member of the Institute of Navigation (ION). He published two books, 4 book chapters, 13 patents, and over 300 papers in academic journals, conferences, and workshop proceedings, in which he received several awards. Dr. Noureldin's research has contributed to several projects funded by the government and industry. He has supervised and graduated over 100 highly qualified postdoctoral, graduate, and undergraduate personnel.