Tracking Risks from Multi-path TDoA-based Localization in Wireless Communications

Lan-Huong Nguyen, Van-Linh Nguyen , Yu-Hao Liu
Dept. of Computer Science and Information Engineering, National Chung Cheng University, Chiayi, Taiwan {nlh106p, nvlinh, g11410178}@cs.ccu.edu.tw

Abstract

New antenna technologies like phased array antennas are crucial to enhance high-speed data transmission in 5G and 6G high-frequency communications (mmWave/Terahertz). By exploiting spatial-temporal beamforming space (e.g., angle of arrival, angle of departure, time of arrival), directional antenna technologies can enable precise radio positioning. The feature has tremendous potential to be used in many futuristic applications, such as behavioral monitoring or assisting rescue teams moving inside a dark building. However, besides that positive side, precise radio positioning potentially poses significant tracking risks to mobile users. In this work, we demonstrate a case study of tracking a user in a restricted access building based on passively received signals. We then build an efficient mechanism to regenerate the trajectory of a target device by exploiting the characteristics of directional signals. We also exploit the capability of simultaneous localization and mapping using multipath channel information. Through theoretical analysis and simulation, we found that tracking risks of radio positioning techniques are real and challenging to resolve.

Lan-Huong Nguyen received the MSc degree in computer science from VNU University of Engineering and Technology, Vietnam, in 2016. She received the Ph.D. degree in Computer Science and Information Engineering with National Chung Cheng University, Chiayi, Taiwan, in 2022. Her research interests include vehicular networks, vehicular security, and network optimization.

Van-Linh Nguyen received his Ph.D. degree in computer science and information engineering from National Chung Cheng University (CCU), Taiwan, in 2019. He is now an assistant professor of Computer Science and Information Engineering with CCU. His research interests include network intelligence, edge intelligence, cyber security, and autonomous driving.

Yu-Hao Liu is currently pursuing his MS degree in computer science and information engineering from National Chung Cheng University (CCU), Taiwan. His research interests include cybersecurity, and signal-based surveillance.