A Novel Passive Positioning System Based on Wave Mechanics

Altunkaya, Haktan (School: Ataturk High School of Science)
Gidirislioglu, Selim (School: Ataturk High School of Science)

Present-day positioning systems, mainly Global Navigation Satellite Systems (GNSS) and Local Positioning Systems (LPS) have proven useful in many applications. However, they also have some limitations, including the need for an unobstructed line of sight and stationary transmitters in the case of LPS. These factors can make these systems unsuitable for precise positioning in challenging conditions, such as disaster search and rescue operations. To address these limitations, we have developed a passive positioning system that eliminates the reliance on pre-built ground stations for LPS applications. Our novel positioning algorithm utilizes signals from multiple receivers to calculate the position of the transmitter. This process involves two sub-processes: amplitude-based mapping and superposition-based mapping. While the former can be used standalone, it can be very sensitive to noise. The latter allows us to get more precise position data and effectively decreases noise because the position data is calculated by combining multiple algorithms. Our simulations have demonstrated that the developed positioning algorithm accurately calculates transmitter positions, provided that no errors occur during amplitude and phase calculations. Furthermore, we have conducted some testing in noisy simulation environments, and the resulting error rate of the hybrid algorithm is up to 28 percent lower than the error rate of the purely amplitude-based algorithm. Based on the data we have collected, we believe this positioning algorithm is suitable for a wide range of scenarios such as disaster search and rescue, where GPS or LPS signals are not sufficient for the device to be positioned.

Awards Won: