Abstract

The thesis aims to tackle critical challenges within localization techniques, with the overarching goal of enhancing accuracy, efficiency, and robustness across a wide array of applications. The scope of investigation encompasses multistatic target localization, hybrid localization methods, robust localization in the presence of outliers and Non-Line-of-Sight (NLOS) errors, optimal sensor placement strategies, and novel approaches tailored for scenarios lacking transmitter information. The impetus for this exploration arises from the discernible limitations and gaps prevalent in existing methodologies.

In the initial phase, the thesis provides an introductory overview of localization, exploring its wide-ranging applications and discussing a variety of estimation techniques. Additionally, it offers a concise explanation of multistatic localization, underlining the necessity for hybrid localization methods and robust localization schemes. Furthermore, this segment delves into the importance of optimal sensor placement strategies to improve accuracy in localization techniques.

In the subsequent segment, the thesis introduces a foundational framework for optimization algorithms, notably through the exposition of the Majorization Minimization (MM) architecture. Extensions of this architecture, such as Block Majorization Minimization, significantly contribute to the methodological underpinnings of the research.

The third phase delves into the intricacies of multistatic target localization, confronting various challenging scenarios head-on. Initially, an algorithm designed for joint Maximum Likelihood Estimation (MLE) of both the target position and associated noise variances is introduced, especially when prior knowledge of noise variances is absent. This algorithm demonstrates good performance, substantiated by compelling simulation results. Subsequently, an MM algorithm minimizing the Nonlinear Weighted Least Squares (NLWLS) criterion is proposed, showcasing its robustness in handling NLOS conditions and outliers. Additionally, a localization scheme tailored for scenarios lacking transmitter coordinates and synchronization is presented, leveraging Differential Time Delays (DTDs) from each receiver to enhance applicability and effectiveness in high-noise scenarios. Overall, this phase addresses the inherent

challenges of multistatic localization scenarios through innovative methodologies and rigorous validation.

The fourth segment advances the exploration by seamlessly transitioning into hybrid localization methods, which integrate multiple measurements to enhance accuracy and resilience. Specifically, a unified framework for hybrid localization, encompassing Time of Arrival (TOA), Time Difference of Arrival (TDOA), Received Signal Strength (RSS), and Angle of Arrival (AOA) measurements, is introduced to ensure flexibility and accuracy, particularly in scenarios characterized by NLOS errors. Additionally, a robust hybrid scheme amalgamating TOA and RSS measurements is formulated as a NLWLS problem, demonstrating superior accuracy and computational efficiency.

In the fifth part, the thesis delves into optimal sensor placement strategies, which are essential for enhancing source localization accuracy. Centered on addressing the A-optimal criterion design problem within positioning schemes for hybrid localization, the proposed approach not only improves accuracy but also accommodates D and E optimal criteria. Moreover, it addresses complexities associated with both correlated and uncorrelated noise, thus addressing significant gaps in existing methodologies. Additionally, innovative strategies for optimal sensor placement for 3D AOA measurements and Differential Received Signal Strength (DRSS) measurements are also discussed.

In conclusion, the thesis summarizes its substantial contributions and highlights potential avenues for future research. The innovative methodologies and comprehensive exploration presented significantly contribute to advancing the understanding and practical implementation of localization techniques, particularly in navigating the complexities of various challenging scenarios.