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On the statistical model of source localization based on range difference measurements. (English) Zbl 1373.93320

Summary: In this work we study the statistical model of source localization based on range difference measurements, under the assumption of Gaussian noise on the data. Our analysis is based on a previous work of the same authors concerning the localization in a noiseless scenario. We investigate the case of planar localization of a source using a minimal configuration of three non aligned receivers. We have four curved exponential families corresponding to four different, non disjoint, regions of the feasible set. For each family we solve Maximum Likelihood Estimation (MLE). This requires to find the projection of a point on a set of segments and arcs of ellipse. Then, we perform the analytic study of the localization accuracy. In particular, we give formulas for mean square error and bias of MLE, depending on the displacement vectors. We validate the results through Monte Carlo simulations, in a given setup of the receivers. As the set of feasible measurements is a semialgebraic variety, this investigation makes use of techniques from Algebraic Statistics and Information Geometry.

MSC:
93E10 Estimation and detection in stochastic control theory
93A30 Mathematical modelling of systems (MSC2010)
93E03 Stochastic systems in control theory (general)

Keywords:
statistical model; source localization; range difference measurements; Gaussian noise; maximum likelihood estimation (MLE)

Software:
PHCpack; Bertini; mctoolbox

Full Text: DOI arXiv

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