ASYMPTOTICALLY EFFICIENT ESTIMATORS FOR GEOMETRIC SHAPE FITTING AND SOURCE LOCALIZATION

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ABSTRACT

Solving the nonlinear estimation problem is a challenging task because of the implicit relationship between the measurement data and the unknown parameters. Two kinds of classic nonlinear estimation problems are considered in this thesis: the geometric shape fitting problem and the source localization problem. For geometric shape fitting, the research focuses on the circle and the ellipse fittings. Three iterative methods for the fitting of a single circle: the ML method, the FLS method and the SDP method are provided. Asymptotically efficient and closed-form solutions for both the circle and ellipse fittings are derived. For the source localization problem, based on the TOA measurements, the CRLB and MSE results of a source location when sensor position errors are present are derived. Two closed-formed estimators considering the sensor position errors are proposed. The CRLB and MSE studies are extended to the TDOA and AOA cases to show that situations exist where taking into account the sensor position errors when estimating the source location cannot improve the estimation accuracy. In such cases optimum and suboptimum but practical calibration emitter placement criterions are derived to limit the estimation damage caused by the sensor position errors.