Developments in Recursive Total Least Squares Estimation– A Lagrange Optimization Perspective

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Résumé

Recursive parameter estimation methods tailored to errors-in-variables (EIV) systems have long been focused on extending the classical total least squares (TLS) method based on the singular value decomposition (SVD). Such methods find ways to recursively update the singular vectors of the augmented data matrix of noise-ridden inputs and outputs in a linear EIV system. In parallel to the fields of system identification, signal processing, and automatic control, however, an iterative TLS solution grounded in the nonlinear optimization of the EIV equation has been popularized in the field of geodetics. This opens doors to the development of a new recursive TLS formulation, which closely resembles the classical recursive least squares (RLS) formulation and provides real-time knowledge of the estimated input and output measurement biases. Experiments show that RTLS methods based on said nonlinear Lagrange optimization have more robust properties when compared to SVD-based solutions when catering to ill-posed problems and data with non-uniform noise characteristics.

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