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Backward perturbation analysis for the scaled total least squares problem

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Abstract

Given $A \in \mathbb{R}^{m \times n}$ with $m \geq n$, $b \in \mathbb{R}^m$, and $\gamma \in (0, \infty)$, the scaled total least squares (STLS) problem can be defined as follows:

$$\min_{E,f,x} \{\|[E, \gamma f]\|_F\} \quad \text{subject to} \quad (A + E)x = b + f.$$

The STLS problem reduces to the ordinary least squares (LS) and data least squares (DLS) problems as $\gamma \to 0$ and $\gamma \to \infty$, respectively. Given an approximate solution $y \in \mathbb{R}^n$ to the STLS problem, we derive lower bounds and an asymptotic estimate for the corresponding backward error. We also present numerical experiments, and discuss how our results could be useful for the design of stopping criteria for iterative solution methods.

This is joint work with Professors Xiao-Wen Chang and Chris Paige.