The numerical stability of sketched GMRES

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Abstract

We will present results of a new backward stability analysis of sketched GMRES for solving linear systems, and show that under certain assumptions, sketched GMRES is backward stable provided the condition number of the generated Krylov basis is not too large. Under additional assumptions, we then show that the stability of a restarted implementation of sketched GMRES can be independent of the condition number of the Krylov basis, and restarted sketched GMRES is backward stable. We also present sharper bounds that explain why the backward error produced by sketched GMRES can be small even in cases where the Krylov basis is very ill-conditioned, which has been observed in the literature but not yet explained theoretically. We present results of numerical experiments to demonstrate the conclusions of our analysis, and also show that adaptively restarting where appropriate allows us to recover backward stability in sketched GMRES.

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