

# A new implementation of the CMRH method for solving dense linear systems

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## Abstract

The CMRH method is an algorithm for solving nonsymmetric linear system in which the Arnoldi component of GMRES is replaced with Hessenberg process, which generates Krylov basis vectors which are orthogonal to standard unit basis vectors rather than mutually orthogonal. The iterate is formed from these vectors by solving a small least squares problem involving a Hessenberg matrix. Like GMRES, this method requires one matrix times vector product per iteration. However it can be implemented to require half as much arithmetic and less storage. Moreover numerical experiments show that this method performs accurately and reduces the residual about as fast as GMRES. The CMRH method is the only method with long-term recurrence which require not storing entire vectors as in the GMRES process for dense matrices. This algorithm require less memory and operation per step.

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