



# THE UNIVERSITY OF CHICAGO

Departments of Computer Science, Mathematics, Statistics, and the Computation Institute  
**SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR**

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## **SOU-CHENG (TERRYA) CHOI**

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### **Minimal Residual Methods for Solving Singular Unsymmetric or Non-Hermitian Linear Equations**

**THURSDAY, November 14, 2013, at 4:30 PM**

Eckhart 133, 5734 S. University Avenue

### **ABSTRACT**

GMRES (Saad and Schultz 1986) is a famed minimal-residual method for solving nonsingular unsymmetric or non-Hermitian linear systems. It may suffer non-benign breakdown on nearly singular systems (Brown and Walker 1997). When working, the solver returns only a least-squares solution for a singular problem (Reichel and Ye 2005).

We present GMRES-QLP, a successful revamp of GMRES, for returning the unique pseudoinverse solutions of singular or ill-conditioned linear systems or linear least-squares problems. On nonsingular problems, it is numerically more stable than GMRES. In any case, users do not need to know a priori whether the systems are singular, ill-conditioned, or compatible; the solver constructively reveal such properties. It leverages the QLP decomposition (Stewart 1999) to reveal the rank of the Hessenberg matrix from the Arnoldi process, incurring only minor additional computational cost in comparison to GMRES. We present extensive numerical experiments to demonstrate the scalability and robustness of the solver, with or without preconditioners or restart.

This is ongoing work by the speaker.

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