

APPLIED MATHEMATICS COLLOQUIUM

"Computing Fundamental Matrix Decompositions Accurately Via the Matrix Sign Function in Two Iterations: The Power of Zolotarev's Functions"

**Yuji Nakatsukasa
(University of Tokyo)**

Abstract: The symmetric eigenvalue decomposition and the singular value decomposition (SVD) are fundamental matrix decompositions with many applications. Conventional algorithms for computing these decompositions are suboptimal for minimizing communication together with arithmetic costs. Spectral divide-and-conquer algorithms based on the polar decomposition can achieve both requirements. This work introduces an algorithm for computing the polar decomposition, employing rational approximation theory: we use the best rational approximant for the scalar sign function due to Zolotarev in 1877. The algorithm exploits the extraordinary property enjoyed by the sign function that a high-degree Zolotarev function (best rational approximant) can be obtained by appropriately composing low-degree Zolotarev functions. This lets the algorithm converge in just two iterations in double-precision arithmetic, with the whopping rate of convergence seventeen. The resulting algorithms for the symmetric eigendecompositions and the SVD have higher arithmetic costs than the QDWH-based algorithms, but are better-suited for parallel computing and exhibit excellent numerical backward stability.

**Friday October 30, 2015 (Special Day)
4:30PM
Room E25-117**

Applied Math Colloquium: <http://www-math.mit.edu/amc/fall15/>
Math Department: <http://www-math.mit.edu>

Massachusetts Institute of Technology
Department of Mathematics
Cambridge, MA 02139



Massachusetts Institute of Technology