

Variational Approximations in Linear Algebra and Quantum Dynamics

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joint work with Ch. Lubich

For the low rank approximation of time-dependent data matrices and of solutions to matrix differential equations, an increment-based computational approach is proposed and analyzed. In this variational method, the derivative is projected onto the tangent space of the manifold of rank- r matrices at the current approximation. With an appropriate decomposition of rank- r matrices and their tangent matrices, this yields nonlinear differential equations that are well-suited for numerical integration. The error analysis compares the result with the pointwise best approximation in the Frobenius norm. It is shown that the approach gives locally quasi-optimal low rank approximations. Numerical experiments illustrate the theoretical results. Extensions to higher-order tensors and variational approximations in quantum dynamics are indicated.