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A Greedy Update Method in Comparison With the GMREST Method for Nonsymmetric Problems

In many applications such as parameter-dependent partial differential equations and control theory, matrix equations of the form

$$\sum_{k=1}^{K} A_k X B_k^T = C$$

are of interest. For k, N, $m \in \mathbb{N}$, the matrices involved are $A_k \in \mathbb{R}^{N \times N}$, $B_k \in \mathbb{R}^{m \times m}$, $C \in \mathbb{R}^{N \times m}$ and the unknown is $X \in \mathbb{R}^{N \times m}$. Often, the matrices A_k are not symmetric. The low-rank solver GMREST from [Weinhandl et al. '19] bases on the GMRES method. Its application is not restricted to positive definite problems and can be applied to such matrix equations. Algorithm 4 from [KressnerSirkovic '15], a greedy rank-1 update method, was also developed for matrix equations of this kind. In the talk, we will compare the greedy rank-1 update method with the GMREST method for different applications. We will point out, why the application of the greedy rank-1 update method to parameter-dependent fluid-structure interaction problems can be crucial while it clearly outperforms the GMREST method from [Weinhandl et al. '19] in most other cases where the matrices A_k are nonsymmetric for all $k \in \{1, ..., m\}$.

Primary author: WEINHANDL, Roman (Otto von Guericke University Magdeburg)

Presenter: WEINHANDL, Roman (Otto von Guericke University Magdeburg)

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