Automated Multi-Level Substructuring for fluid-solid interaction problems

Automated Multi-Level Substructuring (AMLS) is an efficient one-shot method for the analysis of vibrations governed by the eigenvalue problem $Kx = \lambda Mx$ where K and M are sparse, symmetric positive definite matrices. The degrees of freedom are recursively divided into many substructures and a projection space is constructed substructure-wise.
This algorithm can be generalized to vibration problems occuring in fluid-solid interaction which are governed by the nonsymmetric eigenvalue problem

$$\begin{pmatrix} K_s & C \\ 0 & K_f \end{pmatrix} \begin{pmatrix} x_s \\ x_f \end{pmatrix} = \lambda \begin{pmatrix} M_s & 0 \\ -C^T & M_f \end{pmatrix} \begin{pmatrix} x_s \\ x_f \end{pmatrix}$$

where K_s, K_f, M_s and M_f are symmetric positive (semi-)definite stiffness and mass matrices and C a coupling matrix. An error bound for the eigenvalue approximations has been derived using the theory of nonlinear eigenvalue problems.