**Dissection sparse direct solver for indefinite finite element matrices and application to a semi-conductor problem**

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It is well-known that inf-sup condition plays a key role to guarantee the solvability of mixed finite element formulation that deals with incompressibility. Discretized bilinear form results in a linear system with an indefinite stiffness matrix. Uniform inf-sup condition guarantees solvability of the stiffness matrix with the whole degrees of freedom but it is not clear that the matrix is invertible or not on subspaces where either iterative or direct linear solver finds solutions successively during solution procedure.

Dissection direct solver with symmetric permutation, postponing factorization strategy with given threshold, and 2x2 pivoting strategy can find a solution efficiently up to 1 million degrees of freedom on multicore architecture.

The drift-diffusion system describes the state of electrostatic potential and electron/hole concentrations inside the semi-conductor device. This system can be discretized by a mixed finite element approximation with Raviart-Thomas element for current density of electron/hole. The linear system in the Newton iteration to obtain a stationary state of the system consists of indefinite matrix with highly unsymetry due to exponential dependency of coefficient for the current of electron/hole on the electrostatic potential. Dissection solver can stably factorize a such matrix with an appropriate scaling pre-processing.