## Some applications of MUMPs in computational fluid dynamics and electromagnetics

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The lecture will give a review of our recent achievements in computation of flows, study of their stability, and calculation of electromagnetic fields and forces for the needs of materials processing. All these achievements involved an intensive use of MUMPs. We had shown that with the usage of MUMPs it is possible to perform Newton iterations for fully pressure-velocity coupled Navier-Stokes equations. Furthermore, we offered to use MUMPs for computation of Krylov bases for shift-and-inverse Arnoldi eigensolver, which allowed us to solve stability problems on grids having up to 1000<sup>2</sup> nodes. Using these two achievements we were able to study convergence of finite volume method for a series of important benchmark problems, as well as of Czochralski crystal growth melt flow model.

Another application of MUMPS, being developed now, is computation of electric and magnetic fields via solution of coupled Maxwell or Helmholtz equation. This approach allows for a direct computation of divergent-free electric and magnetic field needed for calculation of electromagnetic forces acting on melts of semiconductors during manufacturing of bulk monocrystals.