Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

An efficient immersed boundary projection method for flow around moving bodies[1] WEI-XI HUANG, RU-YANG LI, CHUN-MEI XIE, CHUN-XIAO XU, Tsinghua University, TURBULENCE RESEARCH TEAM — An immersed boundary method based on the projection approach is proposed for simulation of flow over moving bodies. In this framework, the momentum forcing added to the incompressible Navier-Stokes equations acts as a Lagrangian multiplier to satisfy the no-slip condition on the immersed boundary, as the role of the pressure on enforcing the divergence-free constraint. The fractional step method with a fully implicit time-advancement scheme is adopted to compute the system, thus eliminating the CFL limitation. Based on the approximate block LU decomposition, velocity-pressure-momentum forcing decoupling is achieved. Moreover, decoupling of the intermediate velocity components and further decoupling of the three directions of the Cartesian coordinates for each velocity component are also performed. As a result, tridiagonal matrix systems for the intermediate velocity, the pressure Poisson equation, and a linear system for the momentum forcing which is one-order lower than the fluid dimensions, are solved, resulting in a significant saving of the computation cost. Both the temporal and spatial accuracies of the proposed method are tested. For validation, several benchmark numerical examples are presented, including flow over 2D and 3D moving bodies.

[1]The work was supported by National Natural Science Foundation of China (11322221, 11490551).

Weixi Huang
Tsinghua University

Date submitted: 28 Jul 2015 Electronic form version 1.4