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Improving Boundary Condition Stability in PHASTA

1 Introduction

2 Initial Outline of PHASTA

PHASTA begins execution at main, located in phSolver/[in]compressible, depending on which branch is desired. This function initializes MPI, and then calls phasta, located in /phSolver/common. Here, inputs are read and computed in input, and then the solver is run by calling proces, a Fortran routine. Within proces, gendat generates geometry and BC data.

- main
  - initialize MPI
  - phasta
    - initialize PETSc
    - set input data paths
    - input — populate data structures with problem set-up and solver parameters
      - readnblk — read and blocks data
        - read numstart.dat and finds appropriate restart .dat files
        - read geometry from Posix or SyncIO files using phio_readheader
        - calculate maximum number of boundary element nodes
        - initialize constants like ndof, ndofBC, ndiBCB, and ndBCB
        - genblk — reads and blocks connectivity
        - read BC mapping array into nBC
        - read temporary boundary condition code into iBCtmp
        - read BC data into BCinp
        - read periodic BC data into iperread
        - genbkb — generate boundary element blocks and traces for gather/scatter operations
        - read restart data into diffusive flux vector qold, primitive variables uold, and accelerations acold
      - echo global information
      - assert valid input constants (e.g. icoord, navier, iexec) defined in common.h
      - echo solver and integration information
      - genint — generate integration information
      - estimate number of nonzero globals
      - compute fluid thermodynamic properties
    - proces — generate problem data and calls the solution driver
      - gendat — generate geometry and BC data
        - getshp — generate the interior nodal mapping
        - geniBC — generate boundary condition codes

        - genBC — generate the essential boundary conditions
        - work with Dirichlet-to-Neumann BCs (?)
        - genshpb — generate boundary element shape functions
        - genini — generate ICs and initialize time-varying BCs
      - setper and perprep — store inverse of sum of one and number of slaves in rcount
      - LES-specific routines keeplhsG and setrls called as needed
      - initStats — allocate arrays to store flow statistics
      - RANS-specific routine initTurb
      - cardiovascular-specific routine initSponge
      - adjust BCs to interpolate from file inlet.dat, if it exists
      - set up eddy-viscosity ramp specific to NGC/Duct case
      - itrdrv
    - finalize PETSc
  - finalize MPI

Numerical solution of the unsteady Navier-Stokes equations occurs within itrdrv, outlined below.

- itrdrv

- gendat
  - geniBC reads and generates boundary conditios (iBC array)
  - genBC reads and generates the essential boundary conditions (BC array)