User Guide

Curvilinear Navier-Stokes (CNS) C++ Code

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Chapter 1

Code Structure

1.1 Introduction

This curvilinear Navier-Stokes (CNS) C++ code is also known as "cns-koltakov" or, more affectionately, "Sergey's Code," after its author, Sergey Koltakov. It is the third version of the original Fortran code written by Yan Zang at Stanford in the early 1990's (Zang et al., 1994). The original code was serial (one processor). The second version was updated by Cui to run with multiple processors using MPI, and is known as PCUI (Cui and Street, 2001). This latest version of the code is basically a translation of PCUI to C++ using an object-oriented framework, which allowed for the addition of a moving grid (Koltakov and Fringer, 2012). Over the years, these various versions of the code have been used to study a wide range of geophysical flows.

The code is based on the fractional step method of Zang et al. (1994) and includes the LES model of Zang et al. (1993)[1]. It solves the incompressible Navier-Stokes equations on a generalized curvilinear grid with a rigid lid, employing a semi-implicit time integration scheme with Adams-Bashforth for the explicit terms and Crank-Nicholson for the implicit terms. Additionally, it uses the QUICK and SHARP schemes for advection of momentum and scalars, respectively, and solves the pressure Poisson equation with a multigrid method.

1.2 File Summary

The code is contained in the directory `/cns-koltakov`, which contains the following files:

`parameters.dat` Hello

`parameters.h` Hello

`navier_stokes_solver.h/.cpp` Hello

[1]The older versions of the code include the LES model. At present, it has not been written into the C++ version. Someone should do this.

curvilinear_grid.h/.cpp Hello

1.3 Getting Started

Chapter 2

Code Output

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Chapter 3

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Coming soon!

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