Design of CFD Problem Solving Environment based on Cactus Framework

Soon-Heum Ko[1], Kum Won Cho[2], Chongam Kim[1] and Jeong-su Na[2]

[1] Department of Mechanical and Aerospace Engineering,
Seoul National University,
San 56-1 Shillim-Dong, Kwanak-Gu, Seoul, 151-742 Republic of Korea
E-mail: {floydfan,chongam}@snu.ac.kr
[2] Department of Supercomputing Applications,
Korea Institute of Science and Technology Information(KISTI),
52 Eoeun-Dong, Yuseong-Gu, Daejeon, 305-333 Republic of Korea
E-mail: {ckw,ninteger}@kisti.re.kr

Key Words: Cactus, PSE(Problem Solving Environment), Grid Computing

ABSTRACT

Cactus[1] is a general-purpose, modular PSE(Problem Solving Environment) designed for scientists and engineers. Since 1997, the base framework has been developed and mainly applied to large astrophysics simulations[2,3,4,5,6]. Currently, Cactus is under the progress of being applied to various studies including CFD(Computational Fluid Dynamics), quantum relativity, chemical reaction and EHD(Electro-Hydro-Dynamics)[7,8]. Especially for CFD simulations, aerodynamicists at 'Seoul National University' and 'KISTI Supercomputing Center' have been doing a joint work with the main Cactus developers at 'Center for Computation and Technology' and 'Albert Einstein Institute' for developing incompressible and compressible fluid dynamic toolkits.

Most of CFD researchers have interests in parallel and Grid computing as a way to minimize computation time. However, utilizing those technologies require the propound knowledge in computer science. So, many CFD researchers have been collaborating with computer scientists to develop CFD computing environment[9,10,11,12,13,14].

For the development of more generalized CFD problem solving environment, current research aims to make modularised CFD solver on the basis of Cactus framework. Many of computational supports like automatic parallelization, utilization of computational Grid, remote control and steering are already supplied by Cactus. Here, some numerical supports like coordinate transformation, unstructured driver, PLOT3D format data support are newly added for CFD simulation by the collaboration between computer scientists and application researchers. And, compressible / incompressible flow solvers are modularised and implemented into the current Cactus framework. Currently, CFD toolkit can analyze the turbulent flow phenomenon by implementing k-ω SST model[15] and, the improved framework with multi-block support is under development.

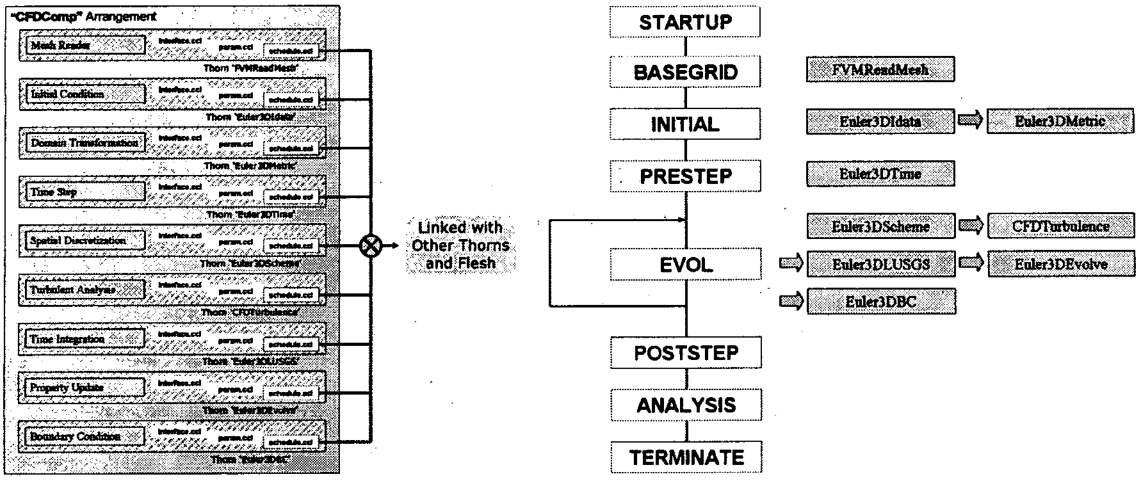

Fig. 1 Structure of Compressible CFD Toolkit and Scheduling Bins

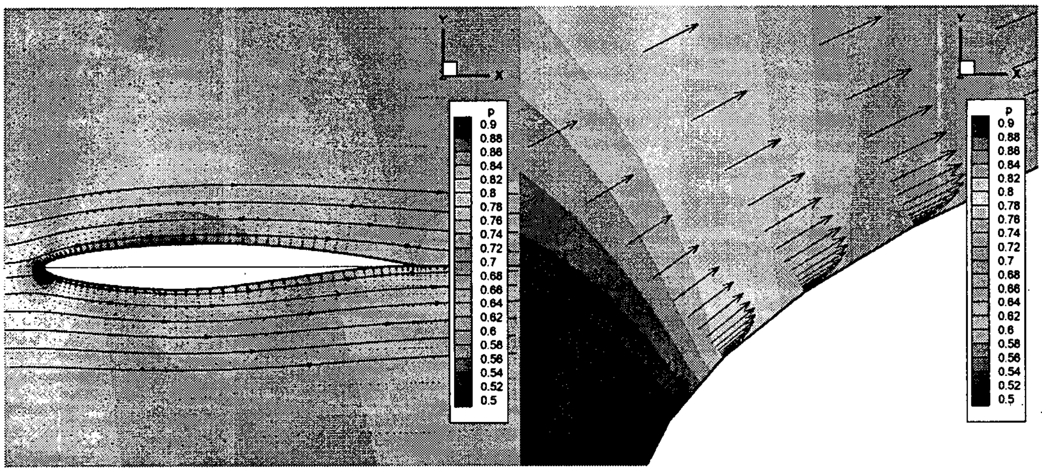

Fig. 2 Pressure Contour with Streamline(L) and Velocity Vector(R) of RAE2822 Airfoil

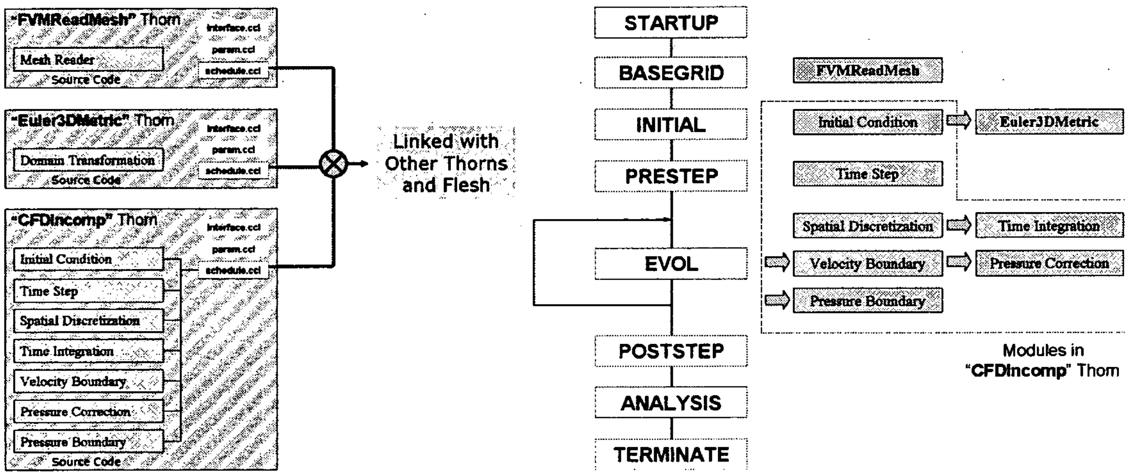

Fig. 3 Structure of Incompressible CFD Toolkit and Scheduling Bins

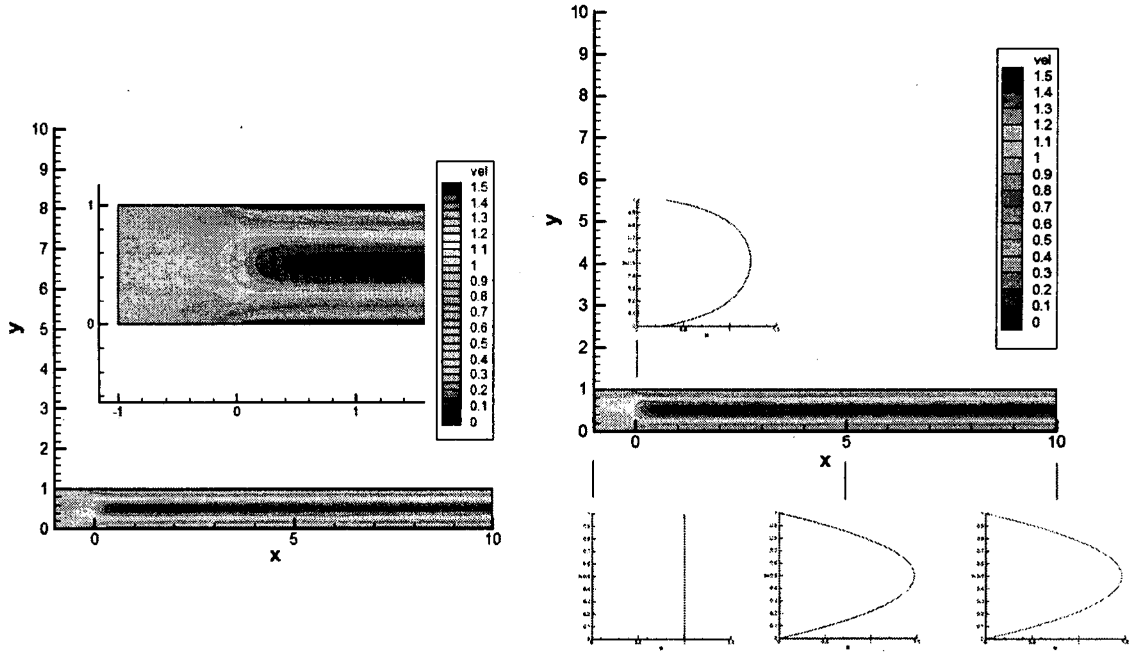

Fig. 4 Magnitude of Velocity(L) and Velocity profile in Channels(R)

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