



Code_Saturne

Since 1997 @EDF R&D

Open-Source Policy, Multi-Physics Coupling, HPC, EDF in-house development



INTRODUCTION

Code_Saturne is a computational fluid dynamics (CFD) open source software which is developed at EDF R&D since 1997.

Code_Saturne 是由 EDF 自 1997 年起自主研发的一款通用计算流体力学开源软件。

It is based on a co-located Finite Volume approach that accepts several existing type of meshes. It solves the Navier-Stokes equations for 2D, 2D-axisymmetric and 3D flows, steady or unsteady, laminar or turbulent, incompressible or weakly dilatable, isothermal or not, with scalars transport if required.

Code_Saturne 基于有限体积方法, 支持多种类型网格, 通过求解纳维-斯托克斯方程, 用于处理二维、二维对称、三维, 稳态或非稳态, 层流或湍流, 不可压或微可压流体, 等温或非等温等多种计算问题。

Several turbulence models are available, from Reynolds-Averaged models (a. k. a. RANS models) to Large-Eddy Simulation models. 拥有多种不同的湍流模型, 例如雷诺平均模型与大涡模拟模型。

MAIN FEATURES

- ✓ User-friendly graphical interface.
易操作的图形界面。
- ✓ Diverse industrial specific physics models.
多种特定的工业应用物理模型。
- ✓ Turbulence models: LES, RANS and URANS (1st moment closure: standard k-ε, k-ε with a linear production, k-ω-SST, φ-model (stabilized version of v²-f), φ-α (elliptic blending); 2nd moment standard (Reynolds Stress Models): SSG (Speziale, Sarkar, Gatski), LRR (Launder, Reece and Rodi), EB-RSM (elliptic blending + SSG)). 多种湍流模型, 包括大涡模拟, 雷诺平均模型等。
- ✓ Mesh flexibility: accepts meshes with any type of cell (tetrahedral, hexahedral, prismatic, pyramidal, polyhedral...) and any type of grid structure (unstructured, block structured, hybrid, conforming or with hanging nodes...).
- 网格适应性强: 可适应任何类型 (四面体、六面体、棱柱体、锥体和多面体等) 与任何结构 (非结构、结构、混合等) 的网格。
- ✓ Mesh joining feature and support of most of existing mesh formats: SALOME SMESH (med), I-DEAS Nx, Gmsh (msh), Gambit (Fluent), Simail, Harpoon, ICEM-CFD (unv) and Star-CCM+ (ccm). 支持网格耦合, 支持多种现存网格格式。
- ✓ Parallel location and exchange capability (MPI) and parallel code couple.
支持并行计算资源分配与信息交互, 可实现多软件耦合并行计算。
- ✓ Powerful and scalable High-Performance Computing capabilities.
强大的大规模超性能计算处理能力。

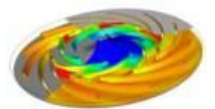
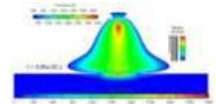
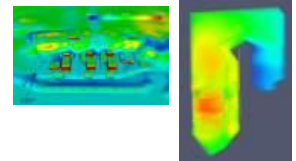
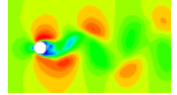
Developer	EDF
Latest release	5.0.0-rc1 / May 26, 2017
Written in	Fortran and C, scripts in Python
Operating system	Linux, Mac OS X, Unix-like, Windows
Platform	Personal computers, Clusters, Supercomputers
License	GNU General Public License
Official Website	http://code-saturne.org

Table 1 Main official information about Code_Saturne

APPLICATION DOMAIN

A number of specific physics models are available: Code_Saturne 包含一些特定的工业应用物理模型:

- ✓ Arbitrary Lagrangian-Eulerian (ALE) method on deformable mesh
针对可变形网格的任意拉格朗日-欧拉方法
- ✓ Atmospheric flows model
大气模拟模型
- ✓ Pulverized coal, heavy-fuel and biomass combustion model
煤粉、重质燃料及生物质的燃烧模型
- ✓ Fluid-structures interaction coupling
流固耦合计算模型
- ✓ Electric arcs and joule effect model
电弧与焦耳效应模型
- ✓ Particle-tracking model
粒子追踪模型
- ✓ Rotor/stator interaction for hydraulic machines
转子/定子对液压机的作用
- ✓ Semi-transparent radiative transfer
半透明体的辐射传热

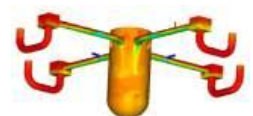
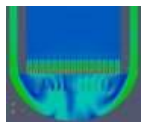
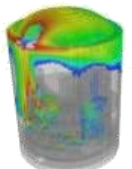
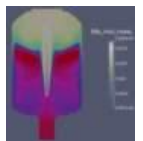


APPLICATION EXAMPLE

In the field of nuclear power, Code_Saturne enables the investigation of complex fluid mechanics and heat transfer calculation inside pipes and containment for single phase flow:

在核电领域, Code_Saturne 用于模拟管道与安全壳内部, 正常工况或事故工况下, 单相流的复杂流动与传热现象:

- ✓ H₂ dispersion inside the containment after severe accident
严重事故下安全壳内的氢气扩散
- ✓ Steam dispersion and condensation
安全壳内蒸汽扩散和冷凝现象
- ✓ Investigation on In-Vessel-Retention strategy and corium behavior
堆芯熔融物堆内滞留和熔融池传热分析的研究
- ✓ Flow diffuser design optimization for PWR reactor
反应堆压力容器的下封头流体分配器的设计优化
- ✓ Identification of new safety margins allowing the extension of plants lifetime
确认新的安全裕度为核电站延寿。



REFERENCES

- [1] F. Archambeau, N. M'chitoua, M. Sakiz (2004) Code_Saturne : a finite volume code for the computational of turbulent incompressible flows - industrial applications, International Journal on Finite Volume