Course Overview

The Finite Volume Method and the associated SIMPLE-family of algorithms are the core numerical tools used in Computational Fluid Dynamic codes. In fact, the top three commercial CFD codes (Fluent, starCD, Numeca); and OpenFOAM, which is one of the most popular open source CFD libraries, are based on the FVM. In the first part of this course, the FVM is presented in details starting with the discretization of the various terms present in the general conservation equation of a scalar quantity as applied on an unstructured non-orthogonal grid. These include the transient, diffusion convection and source terms, in addition to computation of gradients and implementation of various boundary conditions. In the second part, the application of the FVM and the SIMPLE algorithm to the incompressible Navier-Stokes equations are presented in details for a collocated variable arrangement including issues related to boundary conditions. In both parts, implementation details are illustrated using OpenFOAM to ensure that both numerical and implementation issues are clearly treated. In the third and final part, a number of special topics namely High resolution convection schemes, high order transient schemes, treatment of anisotropic diffusion are covered.

Course Content

- Finite volume method and finite volume mesh
- Computing gradients
- Discretization of the diffusion term
- Programming in OpenFoam-I
- Discretization of the convective and transient terms
- Programming in OpenFoam-II
- Discretization of the Navier-Stokes equation: SIMPLE Algorithm and Rhie-Chow interpolation
- Discretization of the Navier-Stokes equation: BC and Advanced Rhie-Chow interpolation
- High resolution schemes and higher order transient schemes
- Programming in OpenFoam-III

Objective

By the end of the course all participants should be able to

- Apply the FVM to discretize any equation involving any combination of convection, diffusion, transient and source terms including energy and momentum conservation equations
- Apply High Resolution Schemes for the discretization of convection and transient terms
- Apply the SIMPLE algorithm to the discretization of the mass continuity equation
- Apply Rhie-Chow interpolation for a variety of flow situations
- Evaluate the types of numerical errors present in a simulation
- Understand the implementation issues involved in writing a CFD code based on the FVM
- Use OpenFOAM to solve a variety of fluid flow and heat transfer problems
- Program OpenFoam to solve a variety of custom flow problems

GIAN
Global Initiative of Academic Networks

Ministry of Human Resource Development, Government of India

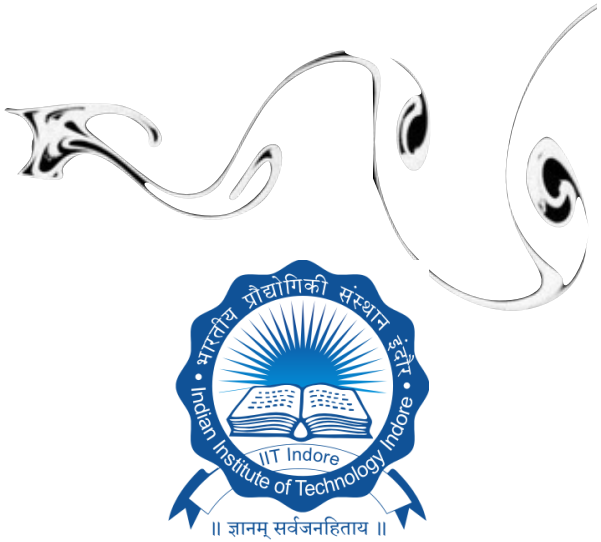
5 days course

on

An Advanced Introduction to the

Finite Volume Methods in Computational Fluid Dynamics (with OpenFoam)

September 5 - 9, 2016



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Teaching Faculty

Marwan Darwish received his PhD degree in Materials Processing from BRUNEL University, London, U.K in 1991. He then joined the Brunel Institute of Computational Mathematics (BICOM), U.K for one year as a post-doc before joining the Department of Mechanical Engineering at the American University of Beirut, Lebanon in 1992, where he currently serves as a Professor. His research interest covers a range of topics in Computational Fluid Dynamics (CFD) including solidification, advanced numeric using the Finite Volume Method (FVM), free surface flow, high resolution schemes, multiphase flows, coupled algorithms, and algebraic multi-grid. He is a founding member of the CFD Group at AUB. He has published over 50 journal papers and contributed over 50 presentation to refereed international conferences.

He recently co-authored a book entitled: “The Finite Volume Method in Computational Fluid Dynamics: An Advanced Introduction with OpenFOAM and Matlab”, the book is published by Springer.

Dr. Marwan Darwish
Professor,
Department of Mechanical Engineering
American University of Beirut, Lebanon

Examination & Certificate

An examination will be conducted at the end of the course and grade sheets as well as participation certificate will be give to all the participants.

Course Coordinator

Shanmugam Dhinakaran is an Associate Professor in the Department of Mechanical Engineering, IIT Indore, India. He received his PhD in the area of Computational Fluid Dynamics and Heat Transfer from IIT Kharagpur, India in 2008. He had worked as a post doctoral researcher at University of Pau, France; University of Minho, Portugal; University of Porto, Portugal and University of Valenciennes, France before joining IIT Indore as an Assistant Professor in 2012. Dr. Dhinakaran is also an adjunct faculty in the Department of Biosciences and Biomedical Engineering, IIT Indore. He is the coordinator of The Centre for Fluid Dynamics at IIT Indore. Non-Newtonian fluid mechanics, Porous media, Nanofluids and Cardiovascular diseases are his research areas.

Dr. Shanmugam Dhinakaran
Associate Professor,
Department of Mechanical Engineering
IIT Indore, India

Who should attend?

- UG & PG Students, Research Scholars, Scientists and Practicing Engineers with background in Mechanical, Chemical, Aerospace, Civil, Biomedical and other relevant branches of engineering.
- Participants with background in applied Mathematics and Physics are also encouraged to apply.

If you wish to know whether you are eligible to attend this course, please contact the course coordinator.

Registration Fee

Students (UG & PG): Rs. 3,000
Research Scholars: Rs. 4,000
Faculty members: Rs. 5,000 | Foreigners: USD 250
Industry and others: Rs. 10,000

Important Dates

Last date for Registration : August 30, 2016
Course schedule : September 5 - 9, 2016

Travel Information

Indore located in Central part of India in Madhya Pradesh State. It will well-connected by rail, road and air. The nearest railway station is Indore Junction and the nearest Airport is Devi Ahilyabai Holkar Airport. For queries regarding travel information, please contact the course co-ordinator.

Accommodation

Paid accommodation will be provided to participants on first-come-first-serve basis.

Contact Details

For any information regarding eligibility, fee payment, travel information, accommodation, etc., please contact the the course co-ordinator via e-mail or phone.

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