**Virtual School on Numerical Methods for Parallel CFD, 30 November-11 December**

First week

**Day 1: Monday, 30 November 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: HPC infrastructures, pre- and exa-scaling** | *label* |
|---|---|---|---|
| 8:30 | 09:00 | Introduction to the school on numerical methods for parallel CFD: aims and objectives<br>I. Spisso/S.Pirozzoli/G. Amati<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA &<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza" | CFD1 |
| 9:00 | 10:00 | HPC CINECA Infrastructure: State of the art, pre-exascale and towards the exascale<br>M. Cestari, G. Amati<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | HPC 1 |
| 10:00 | 11:00 | Principle/re-cap of parallel computing paradigms on standard and heterogeous architectures:<br>MPI, OpenMP, GpGPU<br>G. Amati<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | HPC 2 |
| *11:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | HPC infrastructure@CINECA: overview, proficiency and first steps + hands-on<br>A. Marani<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | TUT 1 |

**Day 2: Tuesday, 1 December 2020** (Afternoon CET Time)

| *Start Time (CET)* | *End Time (CET)* | **Topic: GPUs porting** | |
|---|---|---|---|
| 14:00 | 14:10 | Introduction to Day 2 | INTRO |
| 14:10 | 15:45 | Turblunce through CFD<br>P. Orlandi<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza" | CFD2 |
| 15:45 | 16:00 | *Coffee breakQ&A* | |
| 16:00 | 17:00 | Porting CFD codes to GPU: methodology<br>M. Fatica<br>Director at Nvidia, San Jose, California, US<br>Josh Romero<br>Developer Technology Engineer at Nvidia<br>Portland, Oregon, US | CFD3 |
| 17:00 | 18:00 | Porting CFD codes to GPU: case studies<br>M. Fatica<br>Director at Nvidia, San Jose, California, US<br>Josh Romero<br>Developer Technology Engineer at Nvidia<br>Portland, Oregon, US | HPC 3 |
| *18:00* | *18:15* | *Coffee break* | break |
| 18:15 | 19:15 | GPUs Hands-on with Marconi100 | TUT 2 |

**Day 3: Wedensday, 2 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: Multi-phase flows** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 3 | INTRO |
| 9:00 | 11:00 | Physics and high-performance computation of turbulent flows with interfaces<br>A. Soldati<br>Institute of Fluid Mechanics and Heat Transfer, Vienna | CFD4 |
| *11:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Hands-on: multi-phase flow<br>A. Roncon<br>Institute of Fluid Mechanics and Heat Transfer, Vienna<br>Dept. Mechanical Engineering, University of Udine | TUT 3 |

**Day 4: Thursday, 3 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: Immersed boundary techiniques** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 4 | INTRO |
| 9:00 | 11:00 | Numerical modeling with Immersed boundary techniques<br>R. Verzicco<br>Dipartimento di Ingegneria Industriale, University of Rome "Tor Vergata" /<br>Physics of Fluids Group, MESA+ Institute, and J. M. Burgers Centre for Fluid Dynamics, University of Twente | CFD5 |
| *11:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Hands-on / tutorial: numerical simulation of incompressible flows with AFID<br>F. Viola<br>GSSI - Gran Sasso Science Institute | TUT 4 |

**Day 5: Friday, 4 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: Spectral Methods** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 5 | INTRO |
| 9:00 | 10:30 | Spectral methods and spectral element methods<br>C. M. Casciola<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza" | CFD6 |
| 10:30 | 11:00 | Performance's improvement of Nekbone on heterogeneous HPC architectures<br>I. Spisso, G. Fatigati, A. Memmolo, N. Jansson<br>CINECA/KTH | HPC 4 |
| *10:30* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Tutorial on Nek5000<br>F. Battista<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza" | TUT 5 |

**Second week**

**Day 6: Monday, 7 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: Finite Differences (FD) for compressible flow** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 2 | INTRO |
| 9:00 | 11:00 | Numerical Methods for compressible/high-speed flow<br>S. Pirozzoli<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza" | CFD7 |
| *11:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Tutorial on STREAMS: Supersonic TuRbulEnt Accelerated Navier-Stokes Solver<br>M. Bernardini<br>Department of Mechanical and Aerospace Engineering<br>University of Rome "La Sapienza"<br>F. Salvadore<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | TUT 6 |

**Day 8: Tuesday, 8 December 2020**

PUBLIC HOLIDAY (ITALY)

**Day 9: Wednesday, 9 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: Discontineous Galerkin (DG) Methods** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 9 | INTRO |
| 9:00 | 11:00 | Discontinuous Galerkin Methods (1 ) + Highlights from Hi-Fi Turb<br>A. Colombo<br>Department of Engineering and Applied Science, University of Bergamo | CFD8 |
| *11:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Hands-on with DG / Migale<br>A. Colombo<br>Department of Engineering and Applied Science, University of Bergamo | TUT 7 |

**Day 10: Thursday, 10 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Topic: unstructred Finite Volume (FV), The OpenFOAM framework** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 10 | INTRO |
| 9:00 | 10:00 | OpenFOAM & HPC: state of the art and exaFOAM perspective<br>I. Spisso<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | CFD9 |
| 10:00 | 11:00 | HPC Enabling of OpenFOAM with external linear algebra libraries<br>S. Bna'<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | HPC 5 |
| *10:00* | *11:15* | *Coffee break* | break |
| 11:15 | 13:15 | Tutorial on PETSc4FOAM<br>S. Bna', I. Spisso<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | TUT 8 |

**Day 11: Friday, 11 December 2020**

| *Start Time (CET)* | *End Time (CET)* | **Tools and techinques for profiling in HPC enviroment** | *label* |
|---|---|---|---|
| 08:50 | 09:00 | Introduction to Day 11 | INTRO |
| 9:00 | 10:00 | Tools and tecnique for profiling in HPC enviroment<br>SCAI's staff<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | HPC 6 |
| 10:00 | 11:00 | Example of use: OpenFOAM<br>SCAI's staff<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | HPC 7 |
| 10:00 | 11:15 | *Coffee break* | break |
| 11:15 | 13:15 | Hands-on with OpenFOAM and bring your own code<br>SCAI's staff<br>SuperComputing Applications and Innovation (SCAI) Department, CINECA | TUT 9 |