HPC FOR INDUSTRY

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3rd HPC Enabling of OpenFOAM for CFD applications, 26th March 2015
CINECA IN FIGURES

• Founded in 1969
• 72 Universities + 4 Public institutions
• 3 sites
• 2 controlled companies (Kion, SCS)
• > 900 employees
CINECA - SCAI

- 1 Tier 0 system (Fermi) e 3 Tier 1 (Galileo, Eurora, Pico)
- Best placement in Top500: #7 (Fermi)
- Best placement in GreenTop500: #1 (Eurora)
- Total storage capacity: >15PB
- HPC services to support public research
  - International: PRACE
  - Italian: ISCRA
- Technological transfer towards industry
SCS SUPERCOMPUTING SOLUTIONS

• Funded in 2003
• HPC services marketing and sales
• Consultancy services (CAE, HPDA)
• Development of integrated solutions (HPC+CAE+HPDA)
HIGH PERFORMANCE COMPUTING

“Centralize a computing capacity in a single system to provide much higher performance than those of a workstation or a desktop computer. This capability is used to solve problems in chemistry, physics, engineering or finance.” (source: HPC Inside)
APPLICATIONS

- Automotive
- Aerospace
- Naval
- Oil & Gas
- Pharma
- Supply Chain
- Heavy Industries
- Light Industries
- Medical Devices
- Finance/Insurance
- Pharma
- Medical Devices
- Electrolux
- Stryker
- Medtronic
- Unipol
- Medtronic
- SACMI
- Bombardier
- Alstom
- Ferrari
- Ferruccio
- Dompé
- Recordati
- ToolsGroup
- Elica
- ARISTON THERMO GROUP
- LUNA ROSSA CHALLENGE 2013
- Azimut Yachts
- Scuderia Toro Rosso
- CRF
- Cento Ricerche Fiat
- Chiesi
- People and ideas for innovation in healthcare
THE HPC IN THE PRODUCT CYCLE

97% of the companies that invested in HPC is increasing their spending (IDC 2013)

SRC: IDC Report on HPC

- Concept Development
- Virtual prototyping
- Engineering
- Prototyping
- Final preparation

TIME
EU PRIORITIES

- EC increased its HPC investment to 1.2B€
- To reach 1 ExaFlops within 2020
- Make more relevant the EU HPC ecosystem
- Make more fair the HPC market for EU operators
THE EU CHALLENGE

Supercomputer Share by Countries (November 2013)

- United States: 264
- China: 63
- Japan: 28
- United Kingdom: 23
- France: 22
- Germany: 20
- India: 12
- Australia: 10
- Switzerland: 5
- Sweden: 5
- Norway: 3
- Brazil: 3
- Saudi Arabia: 3
- Others: 16
EC ACTIONS

- Strengthen e-infrastructure programs (PRACE)
- Creating PPP to promote the adoption of HPC technologies (ETP4HPC, FoF)
- To develop centre of excellence for application domains
- To promote specific actions to improve applications scalability to exascale class.
- To promote specific actions in order to improve productive technologies (aka power consumption, e.g. DEEP)
- To promote actions to standardize the access services (Cloud, PaaS, IaaS, HPCaaS -> Fortissimo).
THE HPC MARKET

- HPC market is foreseen in constant growth for the next three years (ave. 7.6%, IDC data)
- China, US, Korea, Russia leaders claimed that HPC is the key to competitiveness of their industry.
- Among segments, storage will grow the most.
- Big data, particularly HPDA will be trending.
THE CHALLENGES-1

To keep low operational costs (that can reach 20% of the total cost of a HPC system, 20M€/y)

- Cooling
- Partnership CINECA-Eurotech
- Sustainable, eco-friendly datacentre
THE CHALLENGES-2

HPC as a commodity? WTH?

- IaaS vs PaaS
- Security models
- SLA & QoS
THE CHALLENGES-3

To train people in HPC adequately is a priority for EC.

- Summer of HPC Program
- CINECA Schools
- International master in HPC (SISSA+ICTP)
CINECA FOR INDUSTRIES

- On demand technical computing service on a cluster HPC
  - FAST
  - SECURE
  - COMPLETE
  - EASY
- Technical support (CFD, Visualization, DA)
- International network on HPC
HPC IN SIX STEPS

01
Get your account on our user portal.

02
Upload your data on our servers.

03
Set your job.

04
Run the analyses.

05
Focus on your work, we notify when results are ready.

06
Start analyzing your results interactively.
DATA SECURITY

• System access (ISO 27001)
• Cyphered connection
• Access policy on local file system
• Differentiated access policies for industry users
• Access policy on scheduler
• Data Backup
• Disaster recovery
Remote User

Welcome to the Fluent page for Remote test! You must use this page if your input files are on your remote cluster.

Please insert:

Journal File
A file with the command lines for your Fluent test.

Input Files
Input Files: *cas and/or *.dat and all the additional files you need

Version
You must select one of these versions: 2d, 3d, 2ddp, 3ddp

Number of CPUs
How many CPUs do you want to use?

Other Parameters
If you are an expert user, you should use some useful other parameters. Please type "-help" in the box in order to get some information.

Queue
name of the queue your job will be submitted to
PRIVATE USERS MUST USE the queue "reserved"!!

Journal File

Input Files

Version

Number of CPUs

Other Parameters

queue

Submit job
HPC INFRASTRUCTURE

Top500 ranked HPC infrastructure

- Fermi is ranked #7 on June 2012 top500 list
- Galileo is the cluster targeting CAE simulations.
- >1000 Intel Haswell CPUs (8000 cores)

Green500 ranked HPC infrastructure

- Eurora is ranked #1 on the June 2013 green500 list

Dedicated HW for pre/post processing CAE activity

- Dedicated ‘Fat’ nodes enables the management of up to 1TB of shared RAM
OF & HPC: TECHNOLOGICAL CONVERGENCES

HPC Infrastructures
- Moore’s Law has been reached
- Multi-cores and many-cores architectures are pushing scalability efficiency

Open-Source Codes and Languages
- Reliable & robust CFD libraries are now free from license limitations
- Ease of use scripting languages for gluing computational workflows into automated computational experiments

Web Interfaces and Cloud Computing
- Web-based services for automated workflow and collaborative experience
THE 3rd CFD REVOLUTION

- For the first time CFD applications can be designed without any limitations concerning ISV licensing costs that in the last decades represented a well known bottle-neck.

- Open-source CFD libraries are mature, robust and reliable tools that can today compete with ISV softwares in problem solving for a wide range of filed of applications in engineering and physics.

- The ideal workflow able to exploit the technological convergences of open-source technologies and HPC platforms into automated and productive workflows must be re-designed.
CFD analysis
State of the art computational study of fluid dynamics and thermo-fluid dynamics problems

3D complex geometries meshing
Highly automated meshing process of 3D complex shapes; fully-structured, hybrid or unstructured

Parallel CFD
High parallel CFD computations for internal flows and external aerodynamics problems

Shape optimization
Shape design optimization based on CFD data

AUTOMATIC & ROBUST CFD TOOLS +...
Tailored Scalability

Performance indices, including rating, speed-up and efficiency are evaluated for specific cases and settings.

Mesh automation

Highly automated meshing is performed using scripting techniques applied to open-source and third-party software.

Automatic post-processing and reporting

Post-processing, visualization and quantification are standardized into automated workflows.

Web-based interfaces

Overall workflow, is available on flexible web-based technologies for a remote high productive experience.
SCALING-UP

Our working methodology

PoC -> Development -> Production
ARE YOU READY FOR HPC*?

- CAE and particularly CFD are a key factor to improve competitiveness of a manufacturing company.
- HPC is an enabling technology part of innovation strategy for EU G20 countries.
- OpenFOAM on HPC might boost your productivity.
- We are ready to speed up your innovation.
THANK YOU

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