CFD team evolution at CERN

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CFD team supports CERN development
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SUMMARY

1. High performance computing
2. Open source CFD software
Opportunities...

- PC speed and parallel calculation have reduced the numerical solution time (and cost)
- Meshing time (and cost) has dramatically decreased
- CFD is more and more integrated in the design tools
  - Automatic meshing
  - Model/surface importation
  - Subroutine facilities
  - CAD integration
- Interface more and more user friendly
- CFD more and more cheap… but:

The tool has an easy access and gives always a result...
...specific knowledge is required

- Efficiency to build the right model
- Selection of the right numerical solver
- Sensibility to result interpretation
- Training
- Experience
- Knowledge
- Problem sharing

CV group has a CFD team since 1993
ENGINEERING BATCH CLUSTER

- 20 Viglen CPU servers
- 8 core Intel "Nehalem" L5520 chips
- 48Gb of memory
- Low-latency "Net Effect" 10Gb Ethernet
- Optimized for MPI applications under LSF
- Dedicated to CFD Team and BE users

CFD SOFTWARE

- STAR-CCM+ (80 licenses)
- STAR-CD
- OpenFOAM 1.7.1
• Parallel computing speeds up CFD

3,000,000 cells test case
(HiRadMat)
lxbst2000..2020, STARCCM+

Domain decomposition

MEASURED
THEORETICAL MAXIMUM

# Iterations per Wall Clock Time [iter/min]

# Parallel Processes

Parallel computing speeds up CFD
PERFORMANCE EVALUATION 2/3

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Fast interconnection is essential

6,000,000 cells test case (CAST)
lxbst2000..2020, STARCCM+

Domain decomposed across different nodes of the cluster

Domain decomposed across one single node
• Reducing computational time
• Solving more complex problems/geometries
• Solving different versions of the same case
OpenFOAM 1.7.1
(Open Field Operation And Manipulation)

- Open source toolbox
- Meshing, Solving & Post-processing work in parallel
- No licenses constraint
- Conversion to/from major commercial codes formats

- Higher flexibility
- Better exploitation of the computational resources
Radio Frequency Cavity, Mass Flow Rate 0.3 kg/s

VALIDATION 1/2: VELOCITY FIELD

STARCCM+  OpenFOAM
OpenFOAM and STAR-CCM+ predicted the same pressure drop values
CONCLUSIONS

1. CFD is very useful at CERN (design speed up, insight analysis, …)

2. Large computing resources available at CERN allows to perform fast and complex CFD analysis

3. The CFD Team of EN/CV has the specific knowledge required

4. CFD Team is enlarging the CFD tools available in order to better use the resources and increase flexibility
THANK YOU FOR YOUR ATTENTION