

SysFera and ROMEO Make Large-Scale CFD Simulations Only 3 Clicks Away



Benjamin Depardon – SysFera
Sydney Tekam – Tech-Am ING
Arnaud Renard – ROMEO

Manufacturing with HPC

98% of products will be developed digitally in 2020

94 % of USA small and medium manufacturing companies have **not yet adopted** high-performance digital manufacturing

*Bill Magro
Director of HPC software @ Intel*

The problem



SMB



ROMEO

HPC-Center



Making HPC accessible to SMBs

- One mission of the ROMEO HPC Center
- ROMEO is entitled to sell compute hours to SMBs
- Member of HPC-PME
 - French initiative to help SMBs to start with HPC
 - GENCI, INRIA, bpiFrance,
 - 10 tier-2 Regional HPC Centers (Equip@meso) ...
- But... limited support/admin team,
and no CFD engineer
- Industry needs
 - Quality & service
 - Simple access & usage
 - “Desktop environment”



The solution



SMB
TECH-AM ING



WEB PORTAL
SYSFERA



HPC-Center
ROMEO



Outline

- Protagonists
 - ROMEO
 - SysFera
 - TECH-AM ING
- Use Case: Simulating a mixing crystallizer
- Challenge
- Results
- Prospects

University of Reims Champagne-Ardenne (URCA) ROMEO Computing Center



Multidisciplinary university

- arts, medicine, sport, ...
- more than 23 000 students
- a wide initial undergraduate studies program
- graduate studies and PhD program in link with research labs



The ROMEO HPC Center is a platform hosted by URCA

- Member of the digital Research platform *La Maison de la Simulation de Champagne-Ardenne*
- Funded by European Community, French government, Champagne-Ardenne Council and Reims Metropolis
- high performance computing resources
- for both industrial and academic researchers in the region
- an in-depth expertise in different engineering fields: HPC, applied mathematics, physics, biophysics and chemistry.
- first *Cuda Research Center* in France



Integrated in the European HPC ecosystem

- link between large hardly accessible national centers and small research laboratories and SMEs of the region.
- member of the French Tier 2 network *equip@meso* managed by *GENCI*
- member of the European Platform *ETP4HPC*



SYSFERA

- Company created in 2010
- Product Software Vendor
- **SysFera-DS:** Easy access to Cloud & HPC applications
- 11 persons, large majority of developers



« Simplify access and administration of complex applications on hybrid clouds »

TECH-AM ING

- Company specialized in numerical simulation and complex CFD
- Has been working with Romeo since 2011



“Combining its technical skills with ROMEO’s considerable CPU power, TECH-AM ING performs complex systems modelling through HPC and CFD.”

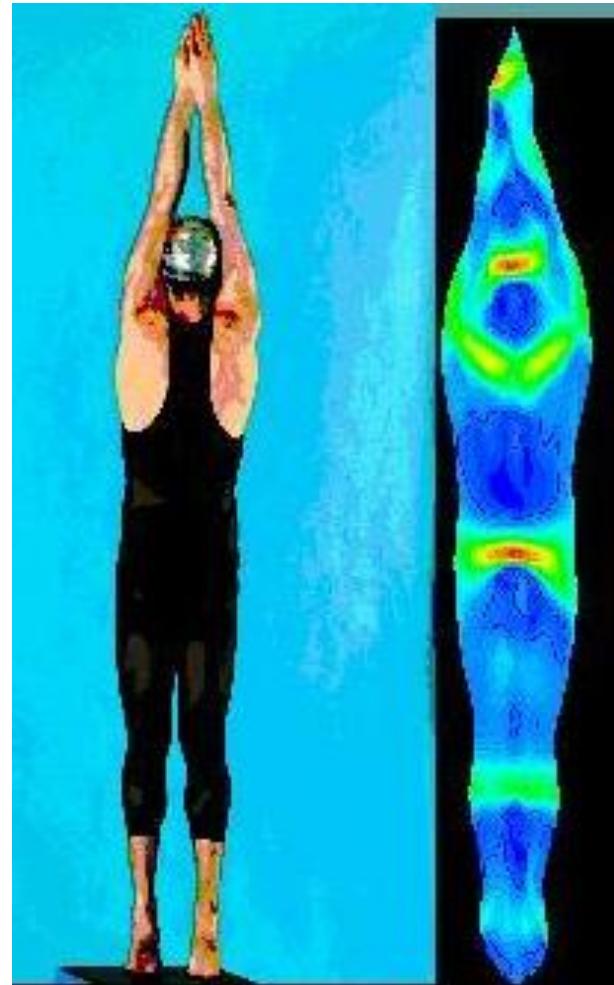
Sydney TEKAM, CEO

Computational Fluid Dynamics (CFD)

Numerical methods to predict fluid flow, heat transfer, mass transfer, chemical reactions...

Applications

- industrial processes (boilers, heat exchangers, combustion equipment, pumps, blowers, piping, etc.)
- Aerodynamics of ground vehicles, aircraft, missiles
- Film coating, thermoforming
- ...



Process for CFD simulations

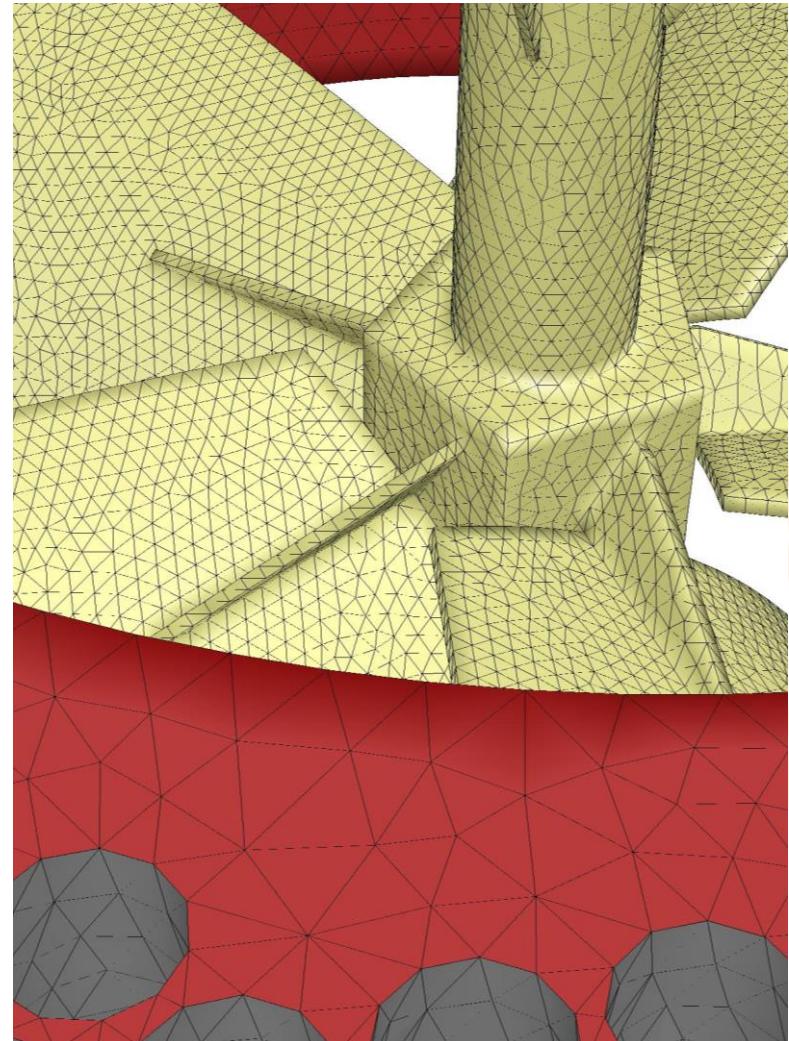
1. Pre-processing

- Geometry
- Mesh
- Physical model

2. Simulation

- Iterative process
- Update parameters
- Quality control

3. Visualize & analyze



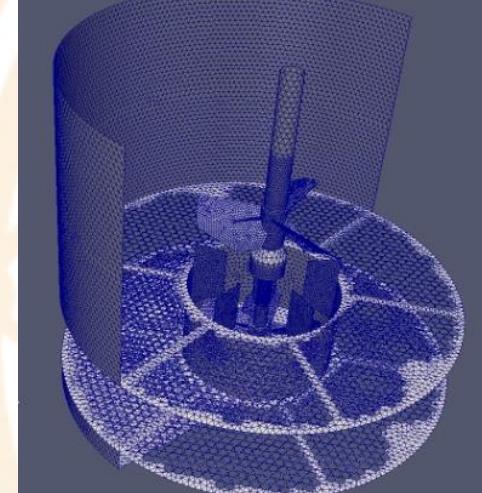
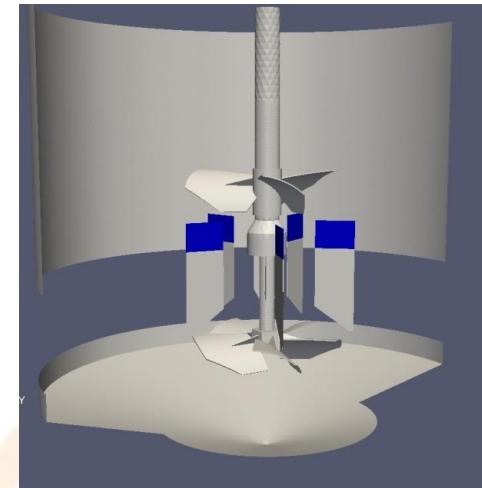
TECH-AM ING's Simulation

Sugar crystallization process

- Customer: Process Mixing Solutions (PMS)
- Transform sugarcane or sugar beets syrup into sugar
- Classical process: heating the syrup during 4 hours

Goals of the study

- Optimize the mixing process
 - Heat transmission
 - Viscosity consistency
 - fan shape, force and power consumption
 - Pumping / melting efficiency
 - Syrup viscosity homogeneity
- Divide by 2 the heating duration (5 KW)
- Double the production (production peaks)



The Crystallizer

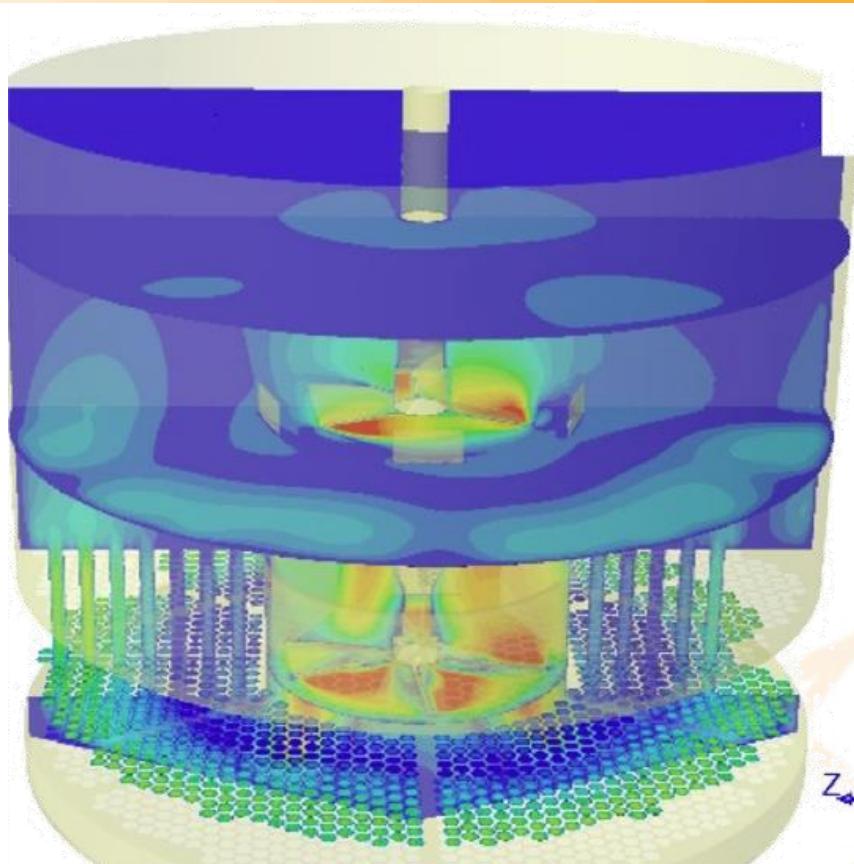
- Ø5m x 5m high tank (16ft)
 - 100 cubic meters (26 Kgal)
- Vertical heat exchangers
 - 227 tubes
 - one meter-high tubes
- Moving fans

➤ 20 million cells mesh

minimum if we want to model precisely the tubes

➤ Simulated process estimated duration: 2 hours

- CFD simulation using ANSYS Fluent® (thanks)
- Process details and system geometry courtesy of PMS (<http://processmixingsolutions.com>)



How to make it 3 clicks away?



SMB
TECH-AM ING



WEB PORTAL
SYSFERA



HPC-Center
ROMEO





ROMEO HPC Tesla Cluster

Compute



5th 3131 MFLOPS/W
Bull Cool Cabinet Door



151th 254.9 Tflops
Linpack



260 NVIDIA Tesla K20X
accelerators

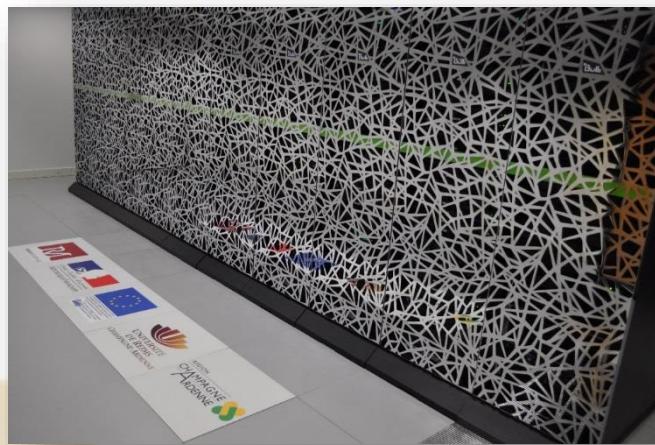


130 Bull servers
bullx R421 E3 – Bull AE & MPI

260 INTEL Ivy Bridge E5-2650 v2 Processor
(2,66 GHZ / 8c), non-blocking **Mellanox Infiniband**, Slurm, 88 To Lustre, 57 To home, 100 To Storage, 42 Westmere nodes
Installation et classements automne 2013



Display



Big Data, on-demand and remote

Quadro 5800, 6000, K6000, K2

Specific solutions

- VirtualGL
- NVIDIA GRID + Citrix Virtualisation
- Windows
- Scalable Graphics

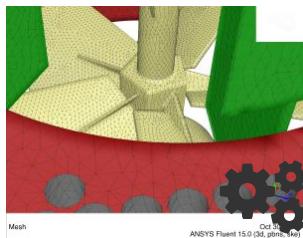
Compatible / standard solution

- X
- VNC
- Batch Scheduler integrated
- Multi-nodes rendering

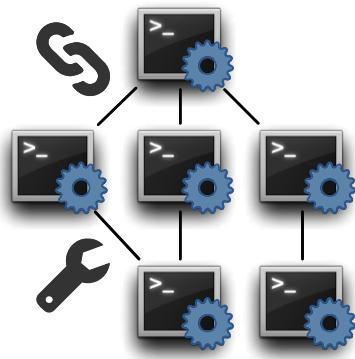


CFD as a Service

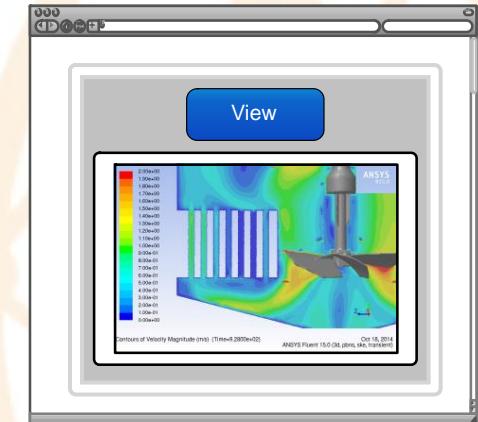
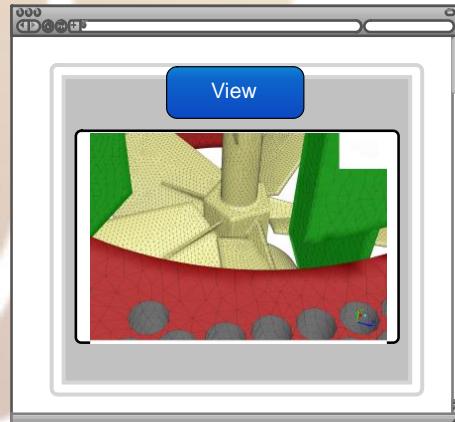
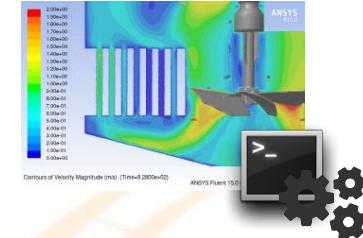
Pre-Processing



Run

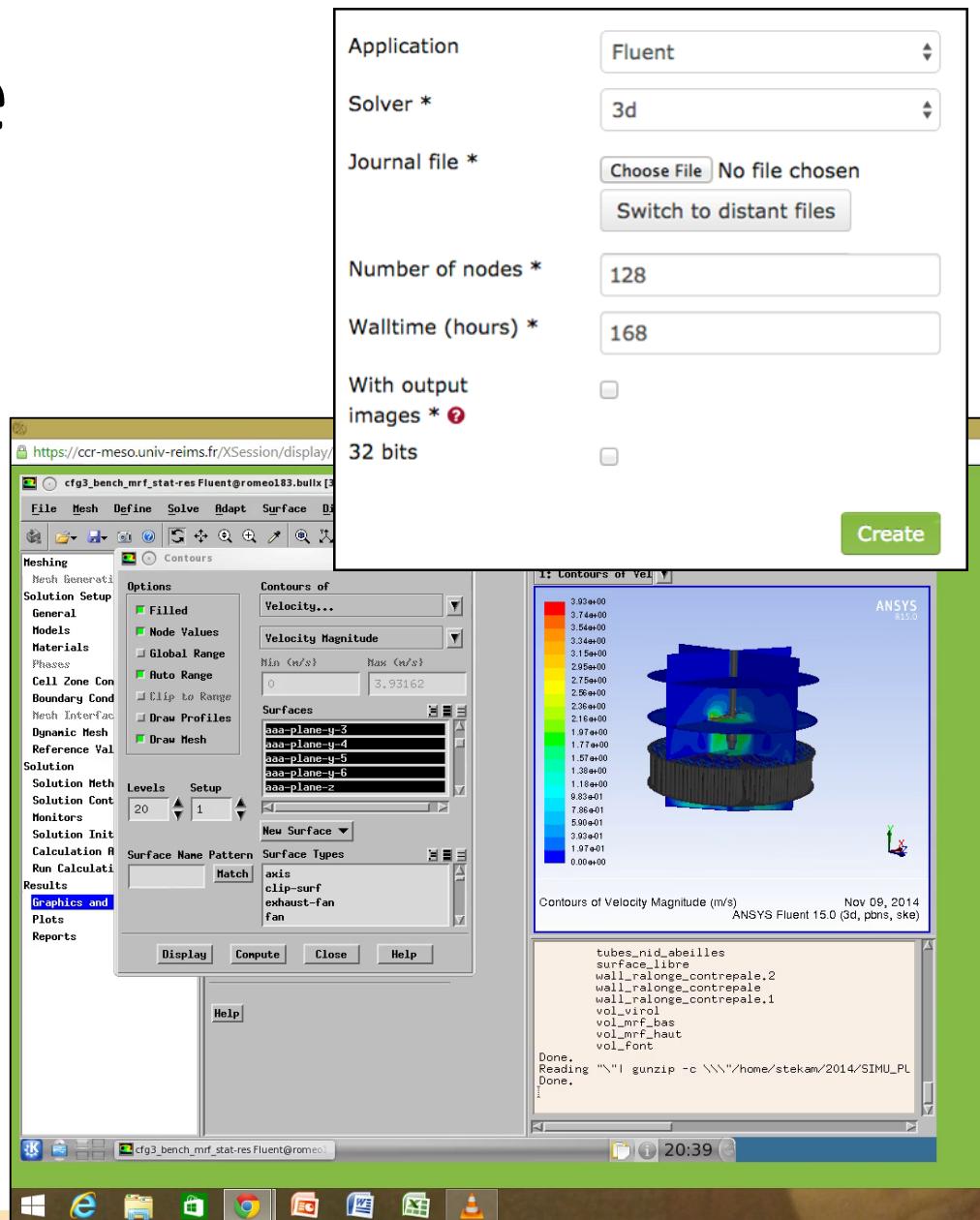


Post-Processing



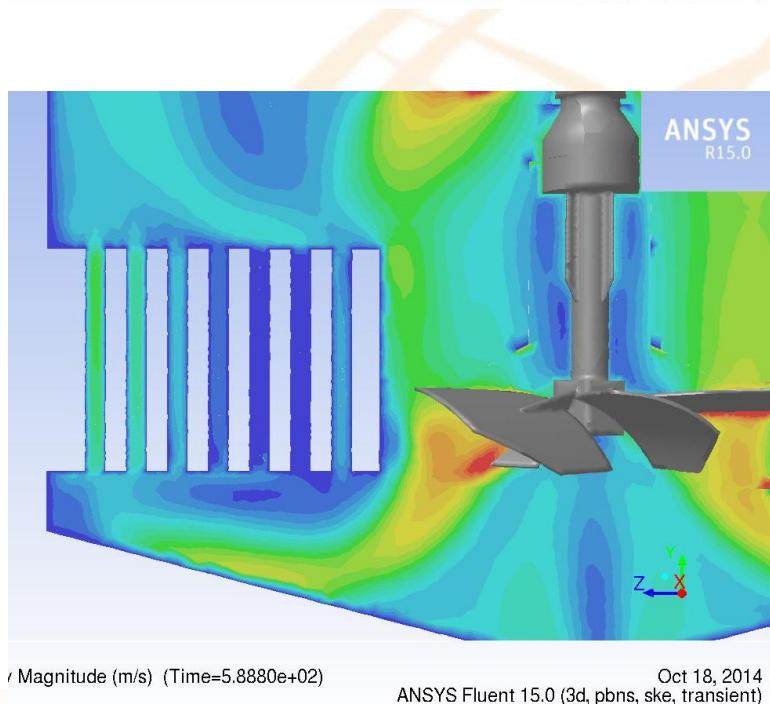
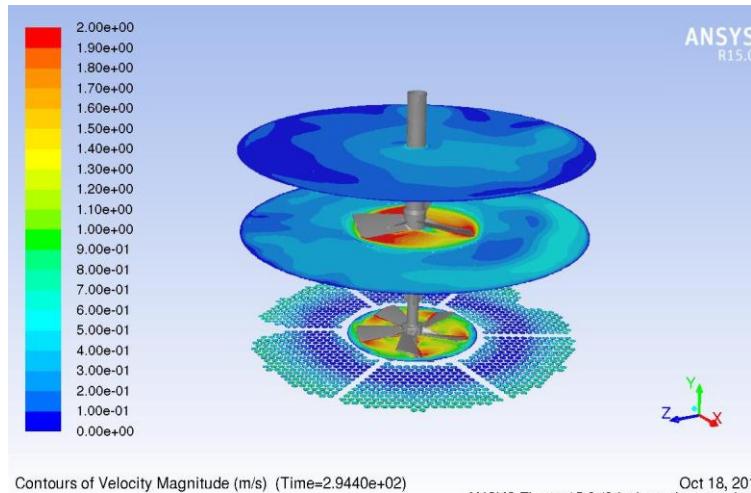
CFD as a Service

- Through SysFera-DS web portal
- Batch tests & simulations
- Post-processing & visualization



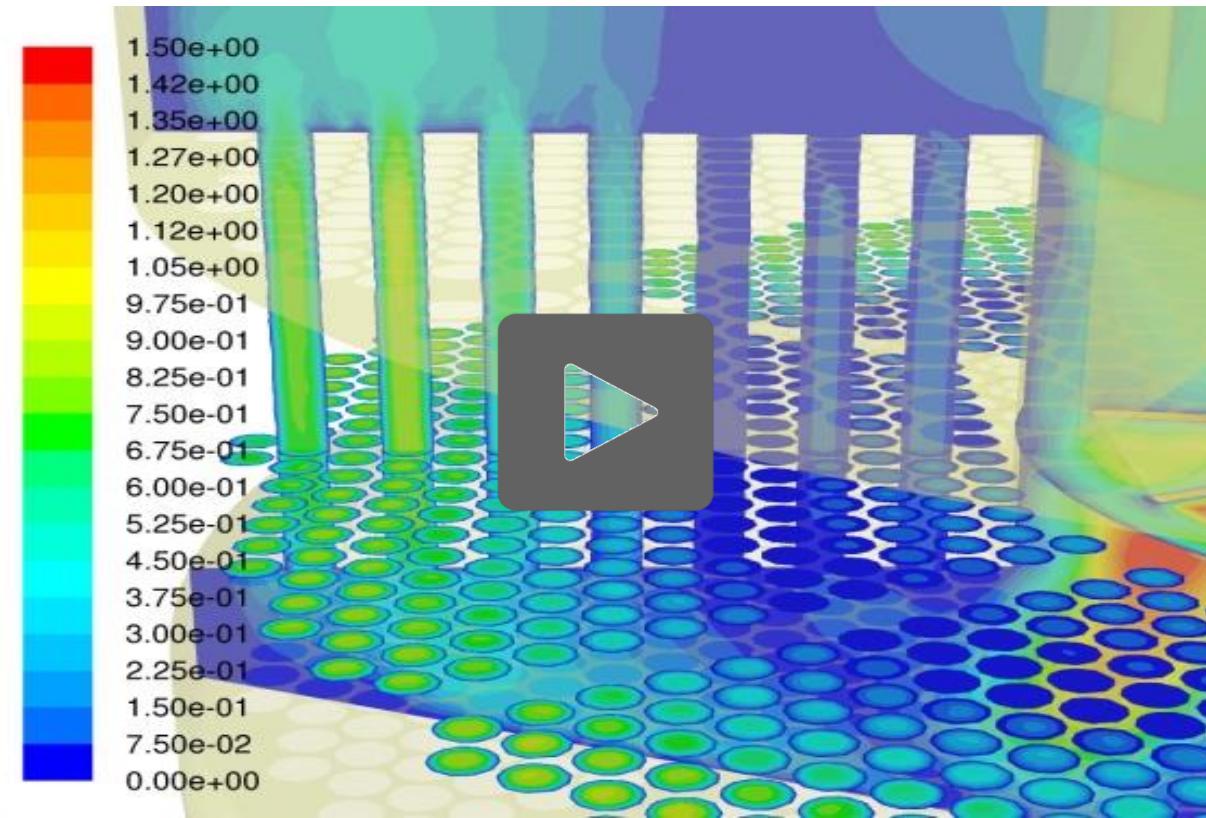
The run

- Parameters
 - Turbulence (k-eps model)
 - Heat exchange physics
 - Moving meshes
- For 4 minutes of simulation
 - 24 hours of processing
 - 1024 cores
- Whole process would take 1 month of processing



Demo (video)

<https://romeo.univ-reims.fr/news/188>



Benefits and impacts

TECH-AM ING & other SMBs

- Simple and immediate access to CFD tools
- New users are autonomous
- Nothing to install on the user side

ROMEO

- Less support needed
- Easy addition of new & tailor made services
- Attract more SMBs
- Other applications for SMBs
- Sysfera-DS available for academic users



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