SALOME USERS’ DAY

News and perspectives

30/11/2021

The SALOME Team (EDF/CEA/OCC)
Introduction
Welcome to SALOME Users’ Day 2021

Ask your questions here

Please make sure to mute your microphone

Ask to be given the opportunity to speak
THE SALOME PLATFORM OFFERS GENERIC FUNCTIONS FOR NUMERICAL SIMULATIONS…

geometry → meshing → computation scheme → visualisation
THE SALOME PLATFORM OFFERS GENERIC FUNCTIONS FOR NUMERICAL SIMULATIONS…

Insert your favourite solver here
THE DISCIPLINARY PLATFORMS
SALOME_* AND MORE
THE SALOME PLATFORM
POSSIBLE USAGES

- Building a model from scratch
- Import/export of CAD and mesh models
- Personalised functionalities for specific physics needs
- Personalised specific platforms when integrating a physics solver
- Specific tools built on SALOME basis for specific engineering applications
- GUI and scripting usage
THE SALOME PLATFORM PROJECT
FACTS AND FIGURES

- Started back in 2000: EDF-CEA partnership
- Open source (LGPL), available here: [www.salome-platform.org](http://www.salome-platform.org)

- More than 150,000 downloads in 2020 (150% increase compared to 2019!)
- Several hundred of users (R&D and engineering)
- 30 people EDF-CEA development team (10 people core)

- About 90 prerequisites from the open source community
- 2,7 million lines: 65% C++, 25% Python, 10% others (compilation & configuration)
- More than 5000 verification tests (from unitary to user real cases, with a focus on CAD and meshing models)
THE SALOME FUNCTIONALITIES
OPEN THE TOOLBOX

- GEOM/Shaper CAD
- SMESH Meshing
- HOMARD Mesh refinement
- EFICAS Data setting model
- YACS Computation orchestration
- YACS GEN Solver integration
- MED
- GUI
- KERNEL
- TECHNICAL BASIS
  Process and data management

- OpenTURNS
  URANIE Uncertainty treatment
- ADAO Data assimilation
- MEDCoupling Mesh and field processing
- ParaViS Scientific visualisation
- JobManager Cluster computation launcher
- Melissa In-situ statistical treatment
- SolverLab PDE solver

Graphical interface
No graphical interface
SHAPER
NEW IMPORT STEP FEATURES

- Names
- Colours
- Optionally:
  - Groups of colours
  - Groups of materials
  - Scale to meters
SHAPER
NEW GROUP FILTERS

- Edge size
- Face size
- Volume size
- Feature edges
- Continuous faces

SALOME 9.8
SMESH
UPGRADED GMESHPLUGIN AWAITS YOU IN SALOME 9.8

- Diverse meshing options
  - Tria/Tetra meshes $\Omega^\square$
    - Delaunay, Frontal, Meshadapt, …
  - Quad/Hex dominant meshes $\Omega^\square > \Omega^\triangle$
    - Recombination, DelQuad, …
  - Full Quad/Hexa meshing $\Omega^\square$ (Repartition of $\Omega^\square$)
  - Hybrid meshing $\Omega^\square + \Omega^\triangle$

- Parallel Multi-threaded meshing
  - Coarse-grain for 2D
  - Fine-grain for 3D – Hextreme (Parallel Delaunay)
    - 64 Threads – 3.2 Million tets/sec

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SMESH
MULTI THREADED MESH VISUALISATION

Large meshes are fine but what about visualisation?

- SMESH GUI parallel Salome 9.7
  - VTK library shipped in OpenMP mode
  - Uses shared memory parallelism
- Thread dependent speedup
  - 10 times for tetra. meshes
  - 3 times for hexa. Meshes
- Faster mesh operations
  - Clipping, shrinking, movements, etc.

Note:
- 30% memory shoot-up
- No support for element selection (removal, enquiry)
To turn off: set SALOME_ACTOR_DELEGATE_TO_VTK=0
HPC
64-BIT INTEGERS

- All Salome modules use by default 64-bit integers for the indexation of numerical fields and meshes
- Capacity to produce and handle very large meshes for reference simulations

Reference simulation of a hydrogen leak in a cavity using a 2 billion cells mesh distributed over 50,000 cores (Élie SAIKALI and al., 2021)
SCIENTIFIC VISUALISATION

THE PARAVIS MODULE

- Based on ParaView, the open source product by Kitware (US company)
- Fields visualisation
- Parametric analysis
- HPC visualisation
- Virtual reality
- Pedagogical visualisation
Ease access to pedagogical visualisation by adding easily a realistic context around datasets coming from simulation.

Static mesh plugin part of Kitware’s plugins has been presented at SC21

- See [https://sc21.supercomputing.org/presentation/?id=rpost107&sess=sess278](https://sc21.supercomputing.org/presentation/?id=rpost107&sess=sess278)
- Objective: convince other users of the very significant performance gains
Custom filters for several physics

- Wide range of physics: mechanics, hydraulics, electromagnetism…
- Custom user interface
- Sequence of multi-filters
- Well-suited for repeated custom post-processing for safety studies
- Make ParaView easier for occasional users
YACS
DISTRIBUTED COMPUTING – CALCULATION SCHEME

- **Dynamic workload management**
  - New way to execute YACS scheme
  - Python oriented
  - Forbid the overload of resources
  - Available since Salome 9.6
    - Used by Odyssée project

- **Other middleware evaluation than CORBA** : **ZeroMQ**
  - Bigger data transfer
  - In study for future versions
YACS
DISTRIBUTED COMPUTING – PARAMETRIC SIMULATION

- Generic interface for parametric calculation

- Initial implementation based on JOBMANAGER and YACS

- New implementations available without YACS (9.7.0):
  - Using `srun` (limited to SLURM)
  - Using `multiprocessing` standard python module (limited to one local resource)

- Used by Persalys
VERIFICATION
LARGE EFFORT ON TEST SHARING, TO BE CONTINUED!

- 1715 tests launched daily by EDF & CEA with “salome test” in parallel with SSL mode: much faster!

- **MCO SALOME qualification done by Open Cascade**
  - 1754 unitary tests
  - 1858 automatic tests and 309 manual tests

- **EDF qualification**
  - 468 EDF specific automatic tests daily done
  - 45 user automatic tests done at each beta phase

- **CEA qualification**
  - 457 automatic tests daily done (SALOME Python tests)
  - 234 automatic graphic tests done with the SQUISH tool
  - 227 manual graphic tests done at each beta phase

Recall: your bugs in the trackers always lead to a test!
SALOME ARCHITECTURE
SALOME SERVER LESS

- Launching servers is no longer required
  - For GEOM/SMESH/SHAPER and YACS
  - All non-regression tests have been switched to this mode

- 2021 observed gains:
  - Faster and robust start of SALOME-GUI
  - Launching workflows in parallel greatly simplified (typically for uncertainties quantifications)
  - Tests on the pre-treatment part are launchable robustly in parallel
  - Implementation of the first WEB servers using preprocessing

<=9.6.0

>=9.7.0
SALOME WEB APP
NEW WAY TO MAKE A SALOME-BASED APPLICATION

- **Objectives:**
  - Reconcile ergonomics / customization / sharing / testing / availability of WebApps without any installation on the client computer and power of optimized servers running on supercomputer
  - Offer an additional technical approach to Qt/PyQt to SALOME-based applications with GUI
  - Offer solutions for integration of SALOME-based applications into constrained information system
  - Offer sandbox into SALOME WebSite to test SALOME without any installation to promote it

- **Concretely, what will be provided into 9.9.0?**
  - Examples of SALOME-Based WebApp and some documentation to implement it
  - Helpers for Jupyter NoteBook to visualise MEDCoupling fields
SALOME WEB APP
NEW WAY TO MAKE A SALOME-BASED APPLICATION

Steer GEOM engine and visualise it

Steer SMESH engine and visualise it

MEDCoupling field visualisation into Jupyter Notebook
BINARY CONVERGENCE
CONTEXT AND OBJECTIVES

- **Context**
  - SALOME is composed by modules developed by EDF and CEA, which are based on open-source prerequisites
  - Each company produces its own declination and adapts the content to its needs.
  - *Increasing time and energy* to build SALOME: 120 compilations units, 12 Linux and Windows, thousands of tests…
  - Maturity of operating systems and code.

- **Objective**: reduce the costs by distributing fairly the burden of the build
  - Convergence of the content (same prerequisites and modules)
  - Convergence of the tests used to qualify the common platform
BINARY CONVERGENCE

RESULTS

- **Actions done in 2021**
  - Sharing of 29 ParaView plugins
  - Integration of Uncertainties tools Openturns and Uranie
  - Integration of Openturns plugins
  - Definition of the list of tests used to qualify SALOME in the user’s environment

- **Benefits**
  - A first version that provides full uncertainties services on all platforms
  - Debian 8 build on CEA site and used at EDF for Calibre9
  - The resolution of complex bugs is facilitated
BINARY CONVERGENCE
THE COST OF IT, AND THE SOLUTIONS

- **Sharing binaries has a cost**
  - A greater number of prerequisites (89 for SALOME 9.8)
  - A more complex and longer build process
  - The size of archives has increased a lot in 20 years (but less than the capacity of hard drives!)

- **Solutions**
  - The use of **system prerequisites** for all recent Linux distributions
  - The distribution of the build process
  - **SALOME on demand** coming soon!
SALOME DISTRIBUTION
AVAILABLE OS

- Published by CEA:
  - CentOS 7 & 8*
  - Fedora 30, 32* & 34*
  - Ubuntu 18 & 20*
  - Debian 9 & 10*
  - Windows 10
  - Universal

- Published by EDF:
  - Calibre 9
  - Scibian 9 (qualified)
  - Scibian 10*
  - SciMotors
SALOME DOWNLOADS
2020 TRAFFIC ON SALOME-PLATFORM.ORG

- 116871 visits
- 153899 downloads

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Nb downloads

Perspectives
SALOME ON DEMAND
JUST GIVE THE INSTALLATION I NEED

- **Problems to solve**
  - Users who want the whole SALOME are rare
  - This access to the bricks is today possible but reserved to developers
  - Gives a bad image of SALOME for new users

- **Specification for SALOME10**
  - Offer an ultra light frontend GUI to download SALOME
  - Let the user choose the services he wants regarding size of installation and # of prerequisites
  - Offer a standalone GUI for each module having a GUI
  - Update (by extension/deletion) user’s application to match user needs

- **SALOME10 and beyond**
  - Extend usage of SALOME frontend to propose free opensource simulation codes
PRE/POST CAPABILITIES

- **Shaper**
  - New functionalities and better ergonomics
  - An improved CAO to mesh link

- **SMESH**
  - High level API for imported shape processing to generate automatically mesh with standard quality
  - Take advantage of new versions of free meshers

- **Visualisation**
  - Common ParaView 3D viewer for all modules
  - Custom filters on demand
NEW WEB SITE
COMING SOON!
SAŁOME TO COME
NEW VERSIONS CALENDAR

- **SAŁOME 9.8**
  - By the end of this year

- **SAŁOME 9.9**
  - May/June 2022

- **SAŁOME 9.10**
  - December 2022

- **SAŁOME 10 (2023)**
  - Containing renewed architecture … and ergonomics
    - All modules on stand-alone usage
    - Customizable Graphical User Interfaces using services from several modules
    - Common 3D viewer
    - SAŁOME on Demand
FOLLOW US ON…

- [www.salome-platform.org](http://www.salome-platform.org)
- [salome.der.edf.fr](http://salome.der.edf.fr) (interne EDF)
- [salome.intra.cea.fr](http://salome.intra.cea.fr) (interne CEA)
- YouTube [here](http://www.youtube.com), [here](http://www.youtube.com) and [here](http://www.youtube.com)
- Our trainings

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TRAITEMENT DE L’INFORMATION SCIENTIFIQUE

- Plateforme SALOMÉ – Module 1 : Prise en main
- Plateforme SALOMÉ – Module 2 : Maillage avec SMESH
- Plateforme SALOMÉ – Module 3 : Modélisation géométrique avec SHAPER
- Plateforme SALOMÉ – Module 4 : Utilisation du modèle de visualisation ParaViS
- Plateforme SALOMÉ – Module 5 : Utilisation de l’assimilation de données avec ADAO
- Plateforme SALOMÉ – Module 6 : Initialisation au scripting dans le module de visualisation ParaViS et Manipulation de maillages et de champs avec le module MEDCOUPLING
Merci