

Overview

The *Code_Aster Professional Network* aims to spread and to acknowledge the benefits of *Code_Aster* Open source and Salome-Meca as open-source software. They make it possible to connect the users within the community beyond the technical and specific exchanges of the forum.

Five actions of utmost importance were retained as a starting point :

- to create multilateral exchanges (with EDF R&D and between the members) of better quality while raising the limits of a public and anonymous forum ;
- to increase the visibility of the members on the various applications carried out and the various usages ;
- to spread privileged information on the roadmaps engaged by the members contributing to the development, including EDF R&D ;
- to gather common requests to service providers ;
- to increase the opportunities of co-operative developments.

These activities began in July 2011.

Regular and special meetings

At the beginning, the activities of the network were focused on semi-annual meetings in France. The eighth meeting was held in **CLAMART** (France) on March 27th, 2015.

Starting last year, special meetings were arranged in various European countries :

- **BARCELONA** in Spain, in June 2014, with the help of TECSIMAT, CSUC and ALTAIR Spain,
- **WROCLAW** in Poland, in October 2014, with the help of NOBO Solutions and Wroclaw University of Technology,
- **LAUSANNE** in Switzerland, in February 2015, with the help of CAE Linux, NRC Tech and EPFL and contribution of Jean-Pierre AUBRY.

A new stage was reached with the realization of a videoconference **FRANCE – CANADA** in March 2015 with help from NECS, for the "Seminar *Code_Aster* 2015" associating Sherbrooke University - Hydro Québec and RTE in **MONTREAL**.

Other solutions will be looked into to facilitate the exchanges between the members of the network and to minimize displacements.

Dedicated forum for the members

The discussions conducted in the ProNet forum are dedicated to all cooperative exchanges between members of the network, expression of needs, follow-up of developments and all feedbacks.

Contact

Jean-Raymond Lévesque – Representative of ProNet
contact@code-aster-pronet.org

New members since April 2014

CANADA



CZECH REPUBLIC



FRANCE



GERMANY



LATVIA - LETONIE



SPAIN



SWITZERLAND



June 2015
63 members
(see last page)

Reporting of the meeting in LAUSANNE at EPFL (Switzerland)

24 participants (service providers, industry, education)

Major contributions of industry users (ROLEX SA, ANDRITZ Hydro, NRC Tech and CAE Linux, members of ProNET) and testimonies from DECISION SA, GEORG FISHER automotive showing their interest.

➔ Testimony of ROLEX SA

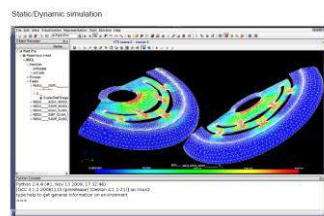


After a first trial in 2010 (1 user) and a complete evaluation afterwards, a "new architecture" was introduced in-house in 2013 and nowadays 10 users who attended training courses are able to use Code_Aster in their everyday job.

Fabiano COLPO (Research and Development Division) said

- Code_Aster is a very rich and powerful FEM code
- Code_Aster is suited for certain watchmaking applications
- Open and modular environment
- Compatibility with Python language : parametrization, optimization, sensitivity study, macros (internal / external, join external libraries, designing own solutions ...)
- Code_Aster is free with no license limitations.

TOPOLOGICAL STUDY OF THE ROTOR MASS



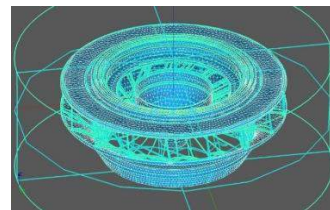
➔ Testimony of ANDRITZ Hydro



Adrien TARUFFI (ZÜRICH) and Stephen ROTH (VEVEY) present the methodology for projects of ANDRITZ Hydro with Code_Aster.

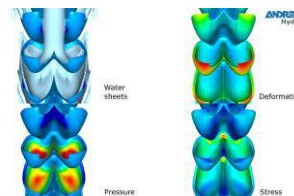
Each **radial runner** (Francis turbine, pump, pump – turbine) design has to be validated with several FEM calculation (static / dynamic), regarding ANDRITZ Hydro guidelines.

These calculations have always been performed using a commercial FEM solver (Ansys). Now an automated tool chain has been set up, using Salome / Code_Aster, so that hydraulic designers can validate radial runners themselves (without having a deep FEM knowledge).



Numerical simulations in **Pelton turbines** : Code-Aster is used in the design process to assess the stress in the runner: Interpolation of pressure fields (calculated from ASPHODEL) on buckets surfaces, Quasi-static simulation.

ASPHODEL is lagrangian mesh-less solver for simulating the free-surface flow, continuously developed by Andritz Hydro and coupled with Code_Aster.



➔ Assessment meeting EPFL

- Exemplary appropriation by ROLEX SA and ANDRITZ Hydro
- Very interesting feedback from CAE Linux and NRC Tech
- Future contacts with Georg Fischer Automotive and DECISION SA
- Opportunities with transducer and watchmaking industry

To be continued organization of a technical seminar to give answers to the remarks and the expressed needs.

News of members

FRANCE

The **LAMSID** laboratory of CNRS becomes **IMSIA** with the partnership of CEA, EDF R&D and ENSTA ParisTech within the framework of PARIS SACLAY University.

GERMANY

New web site for Ingenieurbüro für Mechanik (Johannes ACKVA)

www.code-aster.de

TEACHING CORNER

Recently three teachers joined ProNet for their contributions in the educational courses and research practice in their universities :

Sébastien LANGLOIS
Sheerbroke University

Vincent FRANCOIS
Québec Trois Rivières University

Janis SLISERIS
Riga Technical University

All teachers are welcome in ProNet

Feedback from CAE Linux and NRC Tech in next issue of ProNet Update

appointment Meeting Lausanne II - September 2015

Collaborations between members - Projects

➔ Project SDM4DOE - Numerical experiment design - FUI (France)



To develop an open-source software platform of SDM (Simulation Data Management) for the numerical management of **design of experiments**.

The principal steps of the project are : Data model - Process model - GUI model - Total architecture and computation on HPC Platform.

The project is applied for two industrial cases proposed by :

VALEO for automotive components

NECS for seismic diagnosis with probabilistic calculation

➔ Project ICARE - Nonintrusive coupling - ANR (France)



This project relates to the **non-intrusive coupling** between codes for research and general codes in structural analysis.

The non-intrusive coupling proposes an innovating form of communication between various models:

- minimization of the constraints on topology and the grid: no need of modification of the whole model;
- minimization of the quantity of exchanges (optimization of the computing time);
- minimization of the developments in the codes: the codes remain independent (grids, solvers).

➔ Development of numerical models to account for subsoil variability in soil-structure interaction analysis - European Project NUGENIALOSSVAR



Project LOSSVAR will implement probabilistic numerical SSI models (**soil-structure interaction**) with Code_Aster including spatial variability, compare FULL - FEM approach to simplified analysis with soil springs and FEM - BEM methodology where ground motion variability is introduced via a coherency functions, perform sensitivity analysis and evaluate impact on safety factors.

The proper distinction of random spatial soil variability and epistemic uncertainty is one of the keys to reduce uncertainty.

It is well known that the spatial variability of ground motion has a positive impact on high frequency response of structures (reduced response spectra) but might induce supplementary excitation due to rocking and torsion.

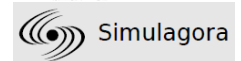
Moreover, the project will implement a V&V procedure including small-scale laboratory tests, benchmarking and sensitivity analysis.

Cloud computing



Engineering simulation in your browser. Flexible and powerful simulation technology on-demand.

<https://simscale.com>



A platform using **web technology** to ease grid computation by leveraging cloud resources.

Study of the dynamic behavior of a pump with Code_Aster on Simulagora by **PHIMECA** for **SICODYN Benchmark**.

www.simulagora.com



HPCspot.

The HPC offer of OVH, features more than 150.000 servers.

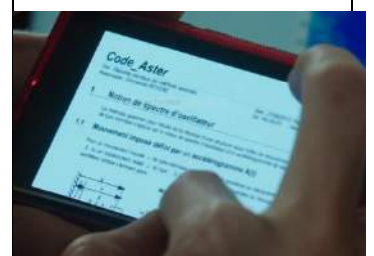
Binaries of Code_Aster parallel version (MPI), are delivered by Alneos with the validation documents proposed by ProNet.

Installation by simple copy and paste.

www.ovh.com/fr/hpc/spot.xml

www.alneos.com

CODE_ASTER ON YOUR SMARTPHONE



« Le bureau des légendes »
French TV show produced by Canal +

Collaborations between members - PHD THESIS

➔ Implementation of S-FEM in Code_Aster



The internship is a collaboration between IFPEN and Aachen University (Germany). The idea of experimenting with S-FEM came after the presentation of Ralf FROTSCHER (Aachen University) at a ProNET meeting.

Aachen University has already coded a "quick and dirty" S-FEM implementation in Code_Aster. We will try to find a proper way of coding S-FEM and this could make it possible to have S-FEM included in official versions of Code_Aster

S-FEM = smoothed FEM : strains are smoothed over smoothing domains. It's a modified version of FEM allowing to obtain accurate results even in presence of:

- Badly shaped elements
- Highly distorted elements

Moreover, the number of degrees of freedom of the model are unchanged. For the same accuracy and the same mesh, S-FEM should be faster than FEM (change of integrals dimension).

Daniele COLOMBO – IFPEN (FRANCE)

➔ The eXtended Finite Element Method (XFEM) applied to porous saturated media



This thesis aims to couple the X-FEM and Hydro-Mechanical elements in Code_Aster to handle discontinuities in geo-mechanics.

The practical application relates to the simulation of fluid exchanges in the matrix and between the fracture and the matrix in a fractured reservoir for oil and gas industry.

The doctoral advisors are **Patrick MASSIN** (IMSIA) and **Richard GIOT** (GéoRessources) and the IFPEN supervisor is **Daniele COLOMBO**.

Bertrand PAUL – IFPEN (FRANCE)

➔ Numerical simulation of cracks and interfaces with cohesive zone models in the extended finite element method, with Code_Aster



In the present thesis, quasi-brittle crack growth is simulated based on the combination of the XFEM and cohesive zone models. These are inserted over large potential crack surfaces, so that the cohesive law will naturally separate adherent and open zones, resulting in an implicit update of the crack front, which makes the originality of the approach.

The doctoral advisors are **Nicolas MOËS** (Ecole Centrale de Nantes) and **Patrick MASSIN** (IMSIA).

Guilhem FERTÉ PhD - Ecole Centrale de Nantes –November 2014

Learning Code_Aster

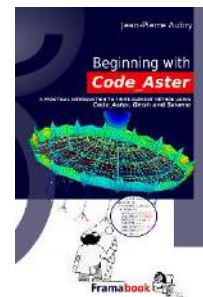
BOOKS

by **Jean-Pierre AUBRY**
(ProNet's member)

A step by step approach to ease the learning curve.

How to put the problem, how to solve it and how to interpret the results.

PDF or LaTeX files are freely available under the GNU FDL, also distributed on paperback by Framabook



TUTORIALS

The course_materials_used by EDF for internal teaching are on line and written directly in English.

Released under the GNU FDL license.

TEST CASES

3200 test cases are the basis of the Verification procedure.

Each test case runs for each change of source, is fully documented (description, mesh data and command file) and very useful for self-teaching.

HANDS-ON TRAINING

All FORMA* test cases are actually practical exercises

CAE LINUX TUTORIALS

Several contributions from the Community Code_Aster.

Contributions of members

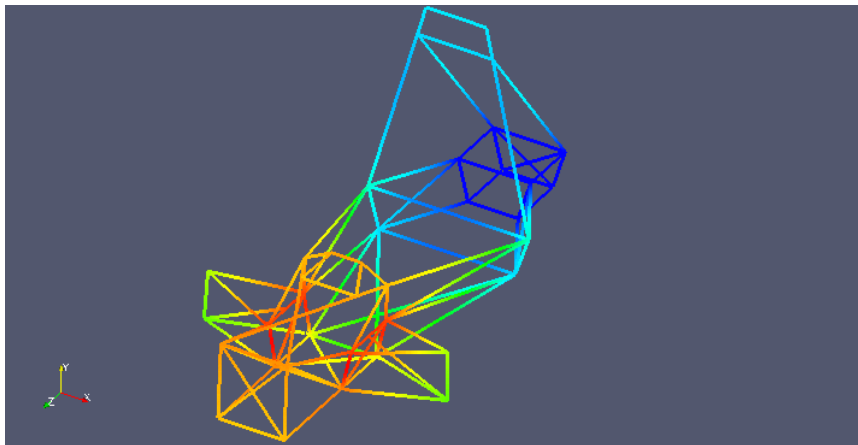
Torsion stiffness and St. Venant's principle



August 29th, 2014

Torsion stiffness is a very important characteristic in chassis design. A stiff chassis has more cornering torque and the suspension can handle it more easily. This post presents results of torsion test performed at **Idra Simulation** using **Code_Aster**.

To perform the test, a simplified beam elements model is built. The loads are applied at the front suspension mounting points, while the displacements are fixed at the rear suspension. To have a realistic distribution of loads, a-arms, kingpin and springs are represented by truss elements.

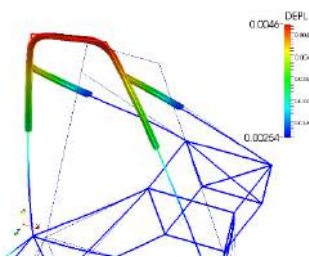


Such simple model is not only useful to estimate and compare different design; it can also be used to obtain detailed results on a region of interest by using the **sub-modeling technique**.

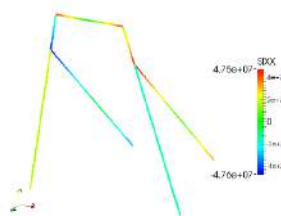
To do so, the displacements calculated at a certain location inside the beam model are specified as boundary conditions for the solid sub-model.

This technique is based on St. Venant's principle, which states that **IF AN ACTUAL DISTRIBUTION OF FORCES IS REPLACED BY A STATICALLY EQUIVALENT SYSTEM, THE DISTRIBUTION OF STRESS IS ALTERED ONLY NEAR THE REGION OF LOAD APPLICATION (1)**.

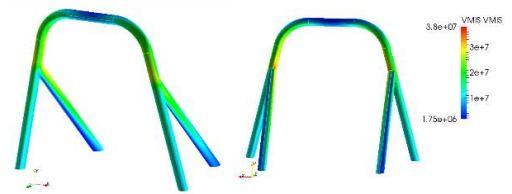
So let say we want a more accurate estimation of the stresses on the upper part of the roll cage. We first "cut" the structure in the middle of the roll cage to retrieve the displacements at those nodes. Then, we apply those values on the solid element model.



Beam model (deformed and original) and deformed solid elements model



Stress in local x direction for the beam model (includes contribution of normal force and bending moments)



Von Mises stress of the solid element mode

Since the beam elements have translations and rotations degrees of freedom, those values cannot be applied directly on the solid elements. For this reason, a node is created at the center of the cut tubes, and rigid beams link it to the solid structure. That way, translations and rotations, can be applied.

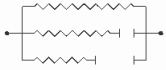
(1) Mac Donald. PRACTICAL STRESS ANALYSIS WITH FINITE ELEMENT. Glasnevin Publishing, 2011

Pierre LAFORTUNE – IDRA Simulation (Barcelona - SPAIN)

www.idrasimulation.com

Implementation of a nonlinear spring for Georg Fischer Automotive AG

April 4th, 2015



Superposition of spring-gap-elements



A nonlinear elastic spring does not exist in Code_Aster. Johannes ACKVA, Ingenieurbüro für Mechanik (www.code-aster.de) suggested the following approach for an implementation: Several line elements are superposed connecting the same couple of nodes. Each line element is a linear spring in series with a gap. Such an element with a spring stiffness and a gap is realized using these Code_Aster commands:

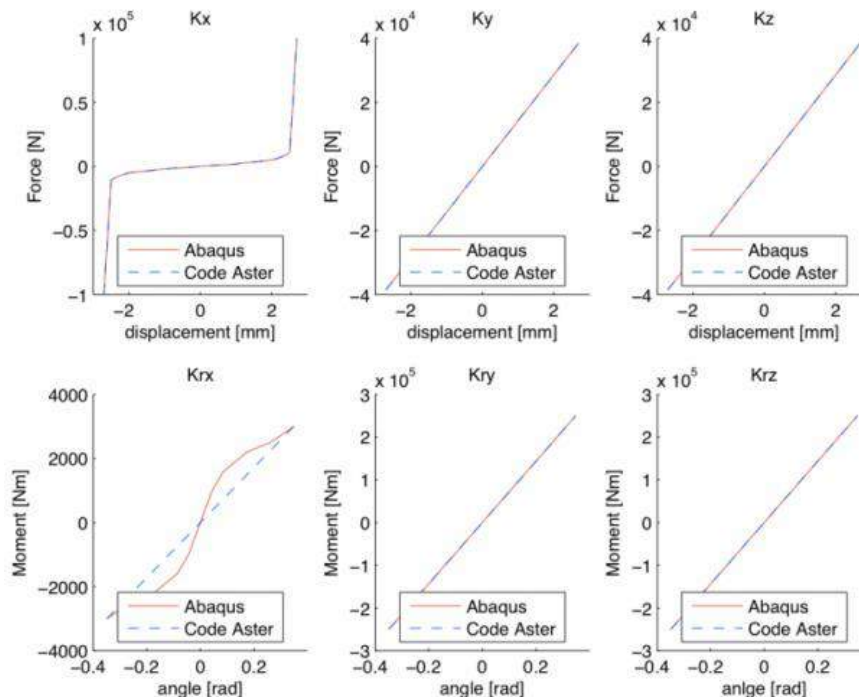
```
MatElm1 = DEFI_MATERIAU (DIS_CONTACT=_F( RIGI_NOR=stiffn1, DIST_1=gap1,))
MatElm2 = DEFI_MATERIAU (DIS_CONTACT=_F( RIGI_NOR=stiffn2, DIST_1=gap2,))  etc

Model=AFFE_MODELE (.. AFFE = (_F(GROUP_MA='AllSpringElms', PHENOMENE='MECANIQUE',
MODELISATION='DIS_T',),),)

Res=STAT_NON_LINE (.. COMPORTEMENT=_F (GROUP_MA='AllSpringElms', RELATION='DIS_CHOC',),)
```

The spring stiffnesses and gap widths are adapted such that a force-displacement curve is approximated (as a polygon) which shows a progressing stiffness in compression. The practical point of this approach: no additional meshing in a PreProcessor is necessary for doubling the line elements because this can be done automatically with the Code-Aster command CREA_MALLAGE(CREA_GROUP_MA...).

So everything is codable in the command-file and runs automatically. This idea was refined using Python to represent all 3 translational and 3 angular spring directions. The figure above shows the comparison of a Code_Aster analysis using this element and results of Abaqus, both representing the same spring characteristics of a rubber element.



Comparison of Abaqus and Code-Aster results

GF Automotive is a recognized development and serial production partner of the automotive industry and industrial applications with 10 production sites in three countries (Germany, Austria, China). The core business is the development and production of high performance castings in iron, aluminum and magnesium. GF Automotive has focused the research& development for years on weight reduction and the reduction of CO2 emissions and efficient fuel consumption.

Johannes ACKVA Ingenieurbüro für Mechanik (GERMANY)
Dirk WEID Georg Fischer Automotive AG (SWITZERLAND)

www.code-aster.de

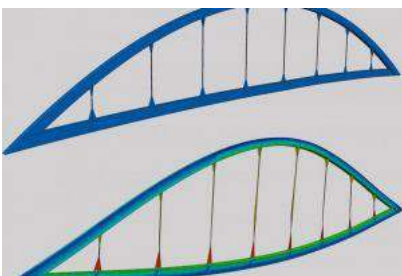
Thermal and Structural Analysis of steel-reinforced concrete exposed to Fire



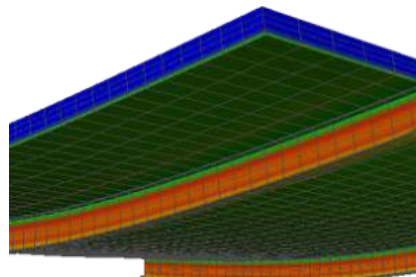
May 28th, 2015

At [MFA Leipzig GmbH, Department "Numerical Simulations"](#) a suitable material behaviour had to be introduced for steel-reinforced concrete in order to describe the highly nonlinear behaviour under mechanical and thermal loads due to fire.

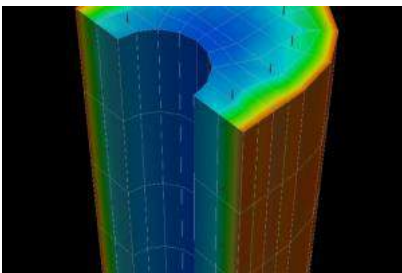
The department "Numerical Simulations" at MFA Leipzig GmbH implements and performs numerical analyses of the development of fire (CFD) and there out arising loads on buildings (FEM). Before introducing Code-Aster MFA had to validate this code for this kind of analyses. The validation report shows that the results obtained with Code-Aster satisfy the standards of DIN EN 1991-1-2 (Eurocode). The validation process was accompanied by Ingenieurbüro für Mechanik.



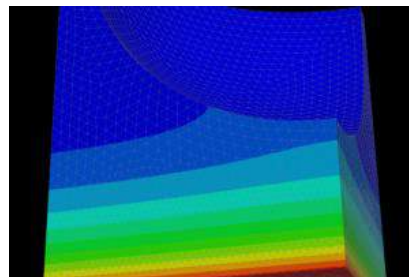
Steel bridge exposed to fire.



Bridge with two steel bars exposed to fire.

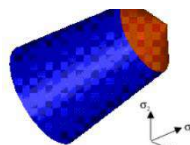


Reinforced column with high strength concrete exposed to fire



Ceiling with cavities exposed to fire

Temperature dependent elastoplastic material models have been introduced. For the concrete a Double Drucker Prager law is used. Different from the simple Drucker-Prager material law which has a cone shaped yield surface, the yield surface of the Double Drucker Prager is formed by the union of two intersecting cones. The second cone cuts the peak of the first one rendering it stump. In this manner plasticity appears at lower stress levels when a body mainly suffers traction ($\sigma_1 > 0, \sigma_2 > 0$ and $\sigma_3 > 0$). Under compression the onset of yield is identical with that of the simple Drucker Prager material. This very particular behaviour is suited for concrete since concrete is very fragile in traction but has very high strength in compression.



Yield surface of the Double Drucker Prager material law

Tom GUDER, responsible at MFA GmbH for structural analysis: "Code-Aster offers all material models we need to simulate concrete structures which are exposed to fire. Often tasks can be automatized by scripting with python. In this manner we simulate a huge number of parameterized concrete structures in batch runs. Result tables, plots and diagrams are all generated by the batch script. Even the technical report is ready after running Latex over the result files being stored during the batch run."

Johannes ACKVA - Ingenieurbüro für Mechanik (GERMANY)
Tom GUDER - MFA GmbH (GERMANY)

www.code-aster.de

63 members in 12 countries

France	France	Switzerland	Italy	France	Spain
France	France	Switzerland	France	France	Spain
France	France	France	France	France	France
Czech Republic	France	Canada	Spain	France	France
Germany	France	Germany	France	Korea	France
France	France	France	United Kingdom	France	France
Poland	Switzerland	France	France	France	Switzerland
Germany	France	Spain	France	Japan	Poland
France	Germany	France	Poland	France	France
Germany	Italy	Germany	Canada	Germany	China
France	Canada	Latvia			

Industrial and research organizations, services providers and teachers are welcome at