ProNet UPDATE - 5

QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK

Code_Aster Professional Network

The *Code_Aster Professional Network* aims to spread and to acknowledge the benefits of *Code_Aster* and Salome-Meca as open-source software.

http://www.code-aster.org/spip.php?rubrique62

This report is the fifth issue, after the first four published since July 2015

See previous issues http://www.code-aster.org/spip.php?article890

Summary of ProNet UPDATE 5

Meetings in France and regional meetings around the world

Support to SMEs for numerical simulation

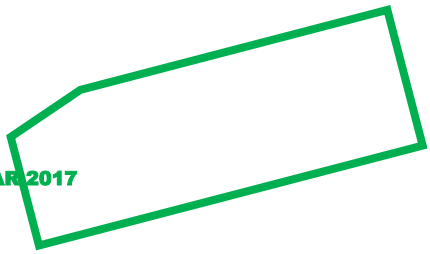
Practical use of GNU Public License

Applications submitted by members

- **TU Wien – ANDRITZ Hydro**
- **SCHÜBELER COMPOSITE - SIMSCALE**

Development corner :

- **PHIMECA – EDF**



Available for download

New training documents - November 27th 2016

Two new training modules were launched in 2016 with the assistance of EDF R&D training organization:

- Introduction to development
- HPC - Accelerating studies

The entire corpus was revamped, especially module 2 (advanced training) and module 4 (civil engineering training).

New releases - December 14th 2016

Code_Aster Open Source versions **stable (12.7)** and **testing (13.3)**

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 *Code_Aster ProNet*

contact@code-aster-pronet.org

New members 2016

ALGERIA

جامعة أبو بكر بلقايد UNIVERSITÉ DE TLEMCEN

SWITZERLAND

coperion K-TRON

FRANCE

TRACTEBEL ENGIE

UK

EDF ENERGY

Imperial College London

MEXICO

CHILE

UNIVERSIDAD DEL BÍO-BÍO

GERMANY

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

ITALY

kobe

aether ENGINEERING

December 2016
73 members
(see last page)

Next regular meetings in France

- **Salome-Meca and Code_Aster User's Day 2017**
  Thursday, March 16th at **EDF LAB** PARIS-SACLAY
- **11th ProNet meeting 2017**
  Friday, March 17th at **EDF LAB** PARIS-SACLAY

Recent special meetings

- **"Numerical modelling with open source software" in Civil Engineering**
  On **November 18th** 2016, over ninety people participated to a workshop organized by the ORDER OF THE ENGINEERS OF THE PROVINCE OF FLORENCE at Scuola di Ingegneria. The workshop featured several contributions on Code_Aster and ProNet in Europe and other workshops are planned in Tuscany.

  Contact University of Florence mbetti@dicea.unifi.it

- **Presentation at Technical Military Academy of Bucharest**

  Students and researchers from TMA, an institution that trains Romanian military engineers, discovered Code_*Aster* and Salome-Meca from **21st to 25th November 2016**. This presentation paved the way for the creation of a digital simulation center around *Code_Aster*.

  Contact ionel.nistor@edf.fr

Next regional meetings

- **Quebec user's meeting Third event**

  For the third consecutive year, the University of Sherbrooke organized on **Thursday May 17th** at **IREQ** (Research Institute HYDRO-QUEBEC) a workshop on structures and mechanics of power lines for users of *Code_Aster* from universities, Hydro-Quebec and RTE.

  Contact sebastien.langlois@usherbrooke.ca

- **Code_Aster training session in China**

  From **February 21st to February 24th 2017**, EDF is organizing a Code_Aster training in **Beijing** jointly with the CAS (Chinese Academy of Science), open to all.

  The courses will be lectured by engineers from the EDF R&D center in Beijing accompanied by Code_Aster developers and will cover both basic functionalities as well as some advanced functionalities in dynamics and fracture mechanics.

  Contact gongchen.zhang@edf.fr and yuting.song@edf.fr

- **University of Manchester and EDF Energy**

  At the end of July 2017, a three day training session for Code_Aster is planned in Manchester (initiation and specific needs).

  Contact Philippe.Martinuzzi@edfenergy.com

TRAINING

For **2016** several organizations propose **training sessions** for ***Code_Aster*** and **Salome-Meca** in France and Germany

PHIMECA

phimeca.com/Formations

DeltaCAD

www.code-aster-services.org

Tangent'delta

www.tgdelta.com/formation-code-aster

Dr.-Ing. J. Ackva Ingenieurbüro für Mechanik

www.code-aster.de/services

see also teaching corner

TUTORIALS

The course materials used by EDF for internal teaching are online and written directly in English.

http://code-aster.org/spip.php?rubrique68

Support to SMEs for numerical simulation

Several government-funded programs help small and medium-sized enterprises to integrate numerical simulation in their innovation or production processes (i.e. mechanical design, conception criteria, risk analysis…).

Code_Aster and **Salome-Meca** as open source solutions create multiple opportunities for this.

in France

SiMCEO coordinated by **GENCI** and **TER@TEC** offers :

- Custom-made support for the deployment or for the improvement of simulation process ;
- A network of scientific and technical experts for case based approach, software training and advanced support ;
- Possible access to regional computing centers ;
- Public funding up to 50% of financial costs.

At present time, **Code_Aster** is implemented on two regional computer center with qualified interlocutors :

- **CRIANN** for the **NORMANDY** area

  Contact Marie-Sophie CABOT marie-sophie.cabot@crihan.fr

  Nicolas MERLETTE nicolas.merlette@tgdelta.com

- **CALMIP** for the **OCCITANIE** area

  Contact Mickaël DUVAL mickael.duval@inp-toulouse.fr

  Nadine MAROUZE nadine.marouze@inp-toulouse.fr

Other organizations are working with the same objectives

- Association **MOSART PME** in **NOUVELLE AQUITAINE** Area

  Contact Jean-Paul PRUHLIERE prulhiere@me.com

- Project **SIMUL PME** in **GrandEst** area

  Contact Nicolas GARDAN nicolas.gardan@dinccs.com

>> Several service providers, members of Code_Aster ProNet, are interested in the accompaniment of all SMEs to use Code_Aster and Salome-Meca in Europe.

in Korea

KISTI and its Division **SMEs Innovation** is in pursuit of future growth and sustainable development of small and medium-sized enterprises. They are actively supported to enhance market competitiveness by offering a sophisticated and customized support program.

Contact Tae Ho Yoon thyoon@kisti.re.kr

Practice use of General Public License

Code_Aster Open Source is distributed under the GNU General Public License (GPL). See http://www.code-aster.org/spip.php?article306

Some members of the community ask questions on the rights and duties attached to this license. You can find here some highlights without any legal value.

The basis of this license guarantees freedom of use,that is for example for personal usage or supply of services to your customers. These services must be clearly identified.

Usage

Everyone in entitled to use the software free of charge, be it for personal or commercial use (for example when conducting studies for a client).

BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY OF THE AUTHORS REGARDING THE PROGRAM AND ITS RESULTS.

The user is responsible for the compilation and/or installation of a particular package on his computer system.

To proof the quality of his own installation, the user should verify it (procedure and test cases for this validation are included in the original distribution).

The user, and eventually his staff, are **responsible of their knowledge of methods** used for modeling, control of the studies and interpretation of results (training documents and usage forum are included in the distribution).

Copying, distribution and modification

You **may copy and distribute** verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty.

This **includes the construction and distribution of pre-compiled package** adapted to a particular computer system.

For all **distributions in a particular environment** (cloud system, distributed computer resources, platform for a dedicated tool ...), **you must publish the original copyright notice** for the Program used underneath. The possibly invoiced financial contribution relates only to the supply of the environment.

If you **distribute the Program with other components or modifications** of existing libraries you must publish the copyright notice for the original Program, the explicit description and documentation concerning your contribution or adjunction.

You are responsible of the validation and the proof of quality of all particular environment or each new contribution.

The authors of the original Program do not ensure any warranty of its operation in this new environment or software modification.

SALOME MECA DOCUMENTATION

Since the release of **Salome Meca 2015.2**

Some documents for Utilization, Validation and Construction of assistant are now freely available

http://code-aster.org/docsmeca

QUALITY ASSURANCE

After the installation of binary package **Salome-Meca** a procedure may be used to **verify the quality** of the versions of Code_Aster packaged with it.

More information may be found in the manual **SV4.02.01 Note for receipt of Salome-Meca**

Applications submitted by members

SCHÜBELER Composite : FEA of Fiber-Reinforced Plastic Parts

Sandro PINENT - Daniel SCHÜBELER - Managers of SCHÜBELER Composite.

Schübeler Composite, founded in 1997, is a German company that is involved with the development and production of fiber-reinforced plastic parts. In their early years, they focused specifically on carbon-fiber-reinforced-polymer (CFRP) axial fans.

Challenge

While getting good analytical results from conventional data analysis, Sandro and his team quickly decided to go one step further with numerical analysis. For FE Analysis they first relied on ***Code_Aster*** but putting effort into the understanding of this complex program constituted a bottleneck. Knowing the advantages of the solver itself Sandro was looking for an easier way to use it.
Soon Sandro realized that **SimScale** makes ***Code_Aster*** accessible to every other engineer in the team.

Simulation

The first project simulated on the **SimScale** platform was an analysis of the stress acting on a turbomachinery blade for model airplanes, which can also be used in motorsports or UAV engines.

CAD model of the blade

The goal was to prove that the blades and mounting could withstand the operation conditions and that the design decisions taken in order to reduce the weight of the elements would not hinder the safety.

Using the step-by-step approach, at the beginning, only the blade was simulated. Static, linear analysis of the stress response of the blade to high rotation speed was analyzed. Having obtained satisfactory results, there were able to begin the investigation of the blade assembly.

Blade mesh

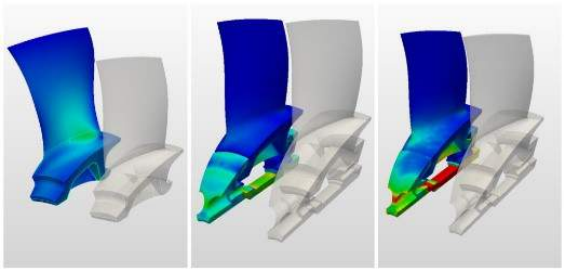
This stage required using non-linear static analysis with physical contacts. Simulations measured stress response and deformation of the system to working conditions of 50 000 rounds per minute revolution speed.

In order to ensure quick analysis workflow, the first simulation was performed on a coarse mesh. After proving that the setup is correct, full-scale analysis on refined mesh was done.

Results

The nonlinear simulation of the blade assembly on the coarse mesh of 20 000 nodes took 24 minutes to run on 4 core machine. A refined full study was done using 95 000 nodes and took 21 minutes on 32 cores. This clearly shows the advantage of having easy access to supercomputer resources.

Results obtained thanks to the simulations have proven that the weight optimized design is safe and can operate properly under working conditions.



The main advantage for SCHÜBELER Composite to use **SimScale** is to have a fast and simple way to get FEM calculation results, that doesn't really require experience with Code_Aster but still provides really quick and reliable results.

Applications submitted by members

Investigation of the fluid-structure interaction of a high head Francis turbine using Open FOAM and Code_Aster

M. EICHHORN, E. DOUJAK, L. WALDNER
TU Wien, Institute for Energy Systems and Thermodynamics, AUSTRIA
28th IAHR symposium on Hydraulic Machinery and Systems – 2016
Adrien TARUFFI – ANDRITZ Hydro – VEVEY - SWITZERLAND

The increasing energy consumption and highly stressed power grids influence the operating conditions of turbines and pump turbines in the present situation. To provide or use energy as quick as possible, hydraulic turbines are operated more frequent and over longer periods of time in lower part load at off-design conditions. This leads to a more turbulent behavior and to higher requirements of the strength of stressed components (e.g. runner, guide or stay vanes). The modern advantages of computational capabilities regarding numerical investigations allow a precise prediction of appearing flow conditions and thereby induced strains in hydraulic machines.

The paper above focuses on the calculation of the unsteady pressure field of a high head Francis turbine with a specific speed of $n_q \sim 24$ min^{-1} and its impact on the structure at different operating conditions.

In the first step, unsteady numerical flow simulations are performed with the open-source CFD software **OpenFOAM**.

To obtain the appearing dynamic flow phenomena, the entire machine, consisting of the spiral casing, the stay vanes, the wicket gate, the runner and the draft tube, is taken into account. Additionally, a reduced model without the spiral casing and with a simplified inlet boundary is used.

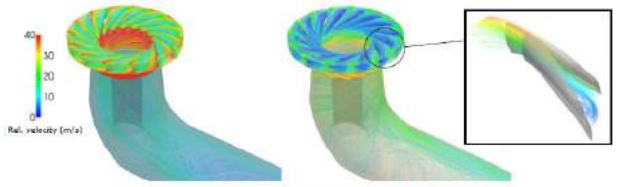


Figure 6: Streamlines at 180 MW (left) and 60 MW (right)

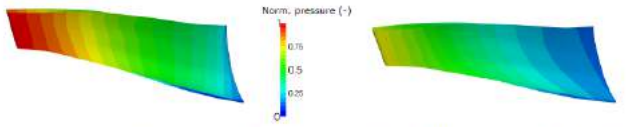


Figure 7: Pressure distribution at the blade pressure side at 180 MW (left) and 60 MW (right)

To evaluate the accuracy of the CFD simulations, operating parameters such as head and torque are compared with the results of site measurements carried out on the corresponding prototype machine.

In the second part, the obtained pressure fields are used for a fluid-structure analysis with the open-source Finite Element software **Code_Aster**, to predict the static loads on the runner, with contribution of ANDRITZ Hydro Company.

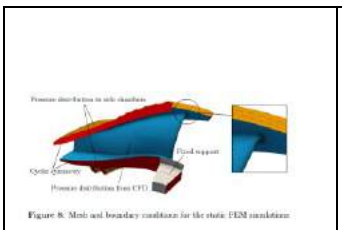


Figure 8: Mesh and boundary conditions for the static FEM simulations

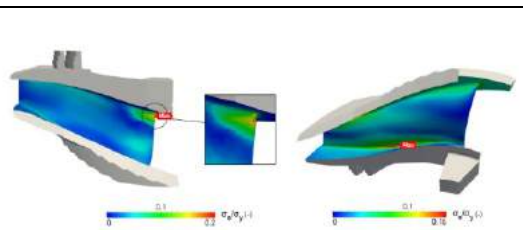
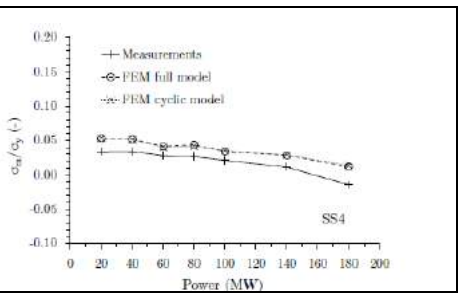


Figure 11: Equivalent von Mises stress at 180 MW (left) and 60 MW (right)



In order to determine the strains on the Francis runner at different operating conditions, static FEM simulations have been performed using a cyclic sector model.

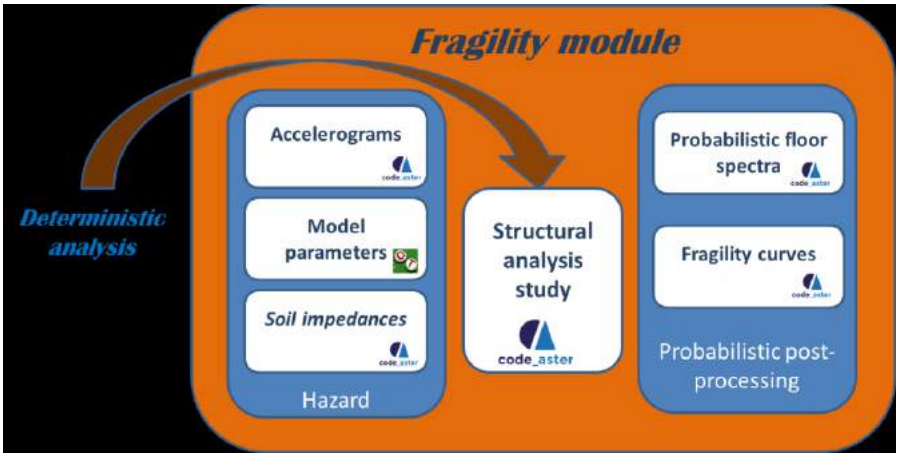
The results reveal a varying behavior regarding the magnitude and location of the maximum stresses due to different pressure distributions in the corresponding operating points. The accuracy of the static FEM simulations has been determined by a comparison with strain gauge measurements performed on the related prototype machine, revealing an appropriate agreement.

Development of module in Salome Meca

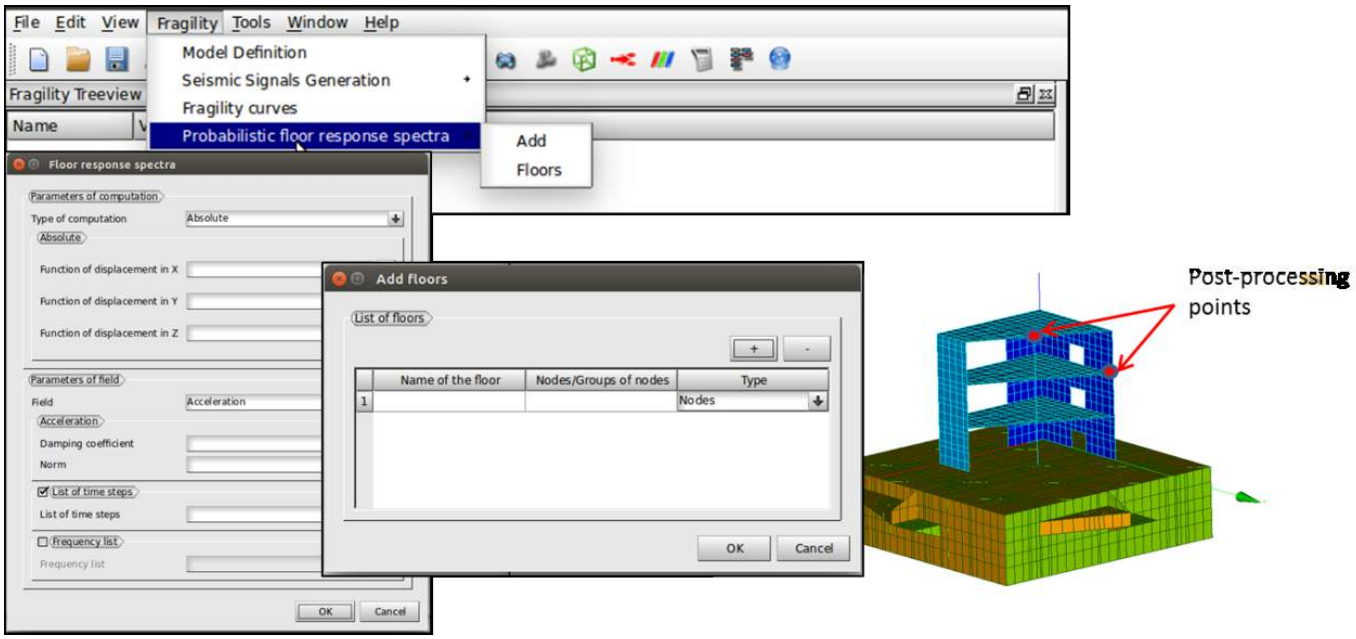
Fragility and floor spectra for seismic analysis

Previously, PHIMECA has presented a mock-up of Fragility module in Salome-Meca. Now, PHIMECA and EDF have signed a partnership agreement to jointly develop a **Fragility curves and probabilistic floor spectra module which aims at helping engineers**:

- To work with better ergonomics,
- To **capitalize** their works,
- To have a better **productivity,**
- To increase the **quality** of the studies,
- To reduce **tedious** and **boring** tasks.



The engineer has only to create a deterministic model and then Fragility module introduces uncertainties at different levels (seismic signals, soil or parameters of the structure) using **Code_Aster** and **OpenTURNS** and performs probabilistic post-processing.



ProNet UPDATE - 5

code_aster ProNet

QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK

Industrial and research centers, services providers and teachers are welcome

73 members - 17 countries

aether ENGINEERING	AIRBUS GROUP	alneos	ANDRITZ Hydro	B.Ing Ingénierie-Etudes-Calculs EF	BC BISCARRI CONSULTORIA	BOUYGUES BATIMENT ILE-DE-FRANCE
Italy	France	France	Switzerland	France	Spain	France
CAE Linux	Cerema	coperion K-TRON	CRIANN	CSUC	DeltaCAD	Centre R&D de DINCCS micado
Switzerland	France	Switzerland	France	Spain	France	France
EC2 MODÉLISATION ETUDE CONSEIL CALCUL	EDF ENERGY	EDF	EGCEM	egis industries	FEMCA Finite Element Method Code Aster	Geo Ressources
France	UK	France	France	France	Czech Republic	France
Hydro Québec	Idrasimulation	ifp Energies nouvelles	INERIS	IMG	IMSIA	Dr.-Ing. J. Ackva Ingenieurbüro für Maschinik
Canada	Spain	France	France	Germany	France	Germany
Imperial College London	INGÉROP	KISTI www.kisti.re.kr	kobe	MECACHROME COMPAGNIE	LafargeHolcim	LaMCoS UMR 5259
UK	France	Korea	Italy	France	France	France
logilab	MaSC MANCHESTER 1824	necs	Nesys Engineering	Nobo solutions	nrctech	PERMASWAGE A PCC COMPANY
France	UK	France	France	Poland	Switzerland	France
PHIMECA	ROLEX	SIMSCALE	STABILIS	Tangent'delta	TECSIMAT Technology Simulation Material	TRACTEBEL ENGIE
France	Switzerland	Germany	France	France	Spain	France
Valeo	Verite Inc. Professional CAE company	ECOLE POLYTECHNIQUE	UWM	GÉOLOGIE	TU BERGAKADEMIE FREIBERG	Lyon 1
France	Japan	France	Poland	France	Germany	France
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Poland	France	France	Germany	Switzerland	Italy	Germany
UNIVERSITÉ DE SHERBROOKE	Fachhochschule Südwestfalen University of Applied Sciences	IPN	SHANGHAI JIAO TONG UNIVERSITY	UPMC SORBONNE UNIVERSITÉS	UQTR ÉCOLE D'INGÉNIERIE Génie mécanique	RTU
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