ProNet UPDATE - 6

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 sixth issue, after the first five published since July 2015 ▼

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

Summary of ProNet UPDATE 6

Meetings in France and regional meetings in the world

Applications submitted by members

- *Biomedical Laboratory, AACHEN University of Applied Science – Germany*
- *Pole Modeling & Calculations CEVAA – France*
- *Aether Engineering – Italy*
- *DICEA (Università di Firenze), Kobe Engineering – Italy*
- *NOBO Solutions – Poland*
- *Cloud computing – SIMSCALE – Germany*

Next release July 2017

A new GUI for *Code_Aster* in Salome-Meca, called **AsterStudy**, has been under development over the past two years, which will considerably improve the user experience of the software. It will bring a revamped module for the input of command files as well as the management of calculations.

AsterStudy will replace the Aster module of Salome-Meca in version 2017. As a consequence, EFICAS for *Code_Aster* will be replaced by the data settings features of AsterStudy. For now, ASTK will remain available for the management of study files and calculations.

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.

Code_Aster Open source for sustainable development join the network ProNet

Contact

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

New members

Since 07/2016

ALGERIA

CHILE

UNIVERSIDAD DEL BÍO-BÍO

UK

Imperial College London

GERMANY

Gantner instruments

ITALY

aether ENGINEERING

kobe

March 2017
75 members
(see last page)

ProNet UPDATE - 6

Training and Meetings in the world

➡️ **In China**

An open-training session on *Code_Aster* was organized by EDF R&D China center jointly with CAS-CNIC (Chinese Academy of Science, Computer Network and Information Center) in **Beijing** from **February 21st to 24th, 2017**.

In total, **33 trainees** from academic and industrial sectors participated in this open training session: CGN, CNNC, SNPTC, SAFRAN China, XJTU, Dalian U., East China University of Science and Technology, Guangzhou U., EDF China, Korean researchers from KISTI (ProNet member) as well as other consulting companies.

Half of the participants were from the nuclear sector. The key nuclear actors in China (CGN, CNNC, SNPTC, XJTU) were all represented in this session. For organization, a local team of 4 people from EDF R&D China and 2 colleagues from EDF R&D/AMA department delivered the complete training session.

This four days training focused on the presentation of the large scope of application domains provided by *Code_Aster* to deal with civil engineering, thermo-mechanics, fracture mechanics), but also to work on the development of dedicated functions or customized software based on **Code_Aster**.

Contacts thomas.de-soza@edf.fr – hassan.berro@edf.fr – gongchen.zhang@edf.fr - yuting.song@edf.fr

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

For the third consecutive year, the University Sherbrook will hold a workshop on Structures and mechanics of power lines on **Thursday May 17th** at **IREQ** (Research Institute HYDRO-QUEBEC), dedicated to users of *Code_Aster* from Universities, Hydro-Quebec and RTE.

Contact sebastien.langlois@usherbrooke.ca

➡️ **University of Manchester and EDF Energy**

On the 13th - 14th - 15th September 2017, a **free** three day training session for *Code_Aster* is planned for introduction to Code_Aster and Salome-Meca, with the new interface AsterStudy. The last day will be dedicated to fracture mechanics modelling.

Contact Philippe.Martinuzzi@edfenergy.com

➡️ **Numerical simulation and sustainable development in Maghreb**

Three meetings between **January** and **April 2017** in **Monastir** (**Tunisia**), **Oran** (**Algeria**) and **Meknes** (**Morocco**) for the deployment of *Code_Aster Open source* in universities and school of engineers as help for local industrial development. More information in the next issue.

Contact Jean-Raymond.Levesque@orange.fr

TRAINING

For **2017** several organizations propose **training sessions** for *Code_Aster* and **Salome-Meca** in France and Germany

phimeca.com/Formations

www.code-aster-services.org

www.cevaa.com

www.code-aster.de/services

TUTORIALS

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

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

Applications submitted by members

Nicolas MERLETTE
Responsible Pole Modeling & Calculations CEVAA - France

www.cevaa.com

Salome-Meca au service de l'ingénierie vibro-acoustique

Diagnostic d'un problème de bruit

Calculer les modes couplés fluide-structure d'un régulateur de pression de carburant, pour identifier la cause d'un sirènement
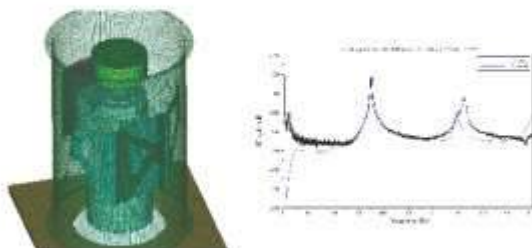
Validation d'un prototype virtuel

Simuler un essai d'endurance d'un système mécatronique pour valider sa tenue mécanique à des excitations vibratoires

Corrélation Calculs / Essais

Construire un modèle précis pour diagnostiquer une rupture pendant les essais d'endurance et permettre un redimensionnement

Modélisation vibro-acoustique

Utiliser un modèle paramétré pour orienter la conception d'une traversée de tablier automobile en phase avancée de développement

Applications submitted by members

Biomechanical Simulation of reconstructing the Female Pelvic Floor Dysfunctions using Mesh Implants

Manfred STAAT, Aroj BHATTARAI, M. JABBARI
Biomedical Laboratory, AACHEN University of Applied Science – Germany

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

www.fh-aachen.de/en/faculties/medical-engineering-and-applied-mathematics

– Motivation –

Female pelvic floor dysfunctions such as stress urinary, incontinence (involuntary urine leakage) and uterine prolapse (uterus falling into the vaginal canal) could be caused by sudden increase of the intra-abdominal pressure (IAP) during physical activities such as coughing, laughing, and others. In old ages, they are induced by the laxity of the supporting ligaments, fascias and muscles. To fix these dysfunctions, more than 20 million prosthetic meshes are implanted each year worldwide [1]. We try to optimize the position and orientation of the mesh implant for maximum support against IAP via the finite element method (FEM) using the software **Salome** and *Code_Aster*.

– Model –

3D finite element (FE) model of a 70 year old female
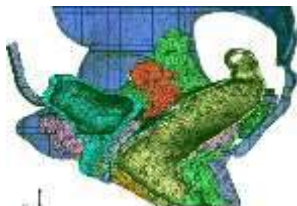
- The hyper elastic material parameters for the Mooney-Rivlin class of strain energy function

$$W = C_{10}(I_1 - 3) + C_{01}(I_2 - 3) + C_{20}(I_1 - 3)^2$$

- C_{10}, C_{01} and C_{20}: empirical hyper elastic material constants
- I_1 and I_2: the first and second strain invariants of the right Cauchy-Green deformation tensor
- Frictionless contact between the anterior and posterior vaginal walls
- FE simulations are performed with an IAP of 10 kPa during straining to analyze the organ response as suggested by the integral theory

Stress Urinary Incontinence (SUI)

- Insertion of an mesh implant inside the fascia behind the urethra at four different positions, for treating stress urinary incontinence
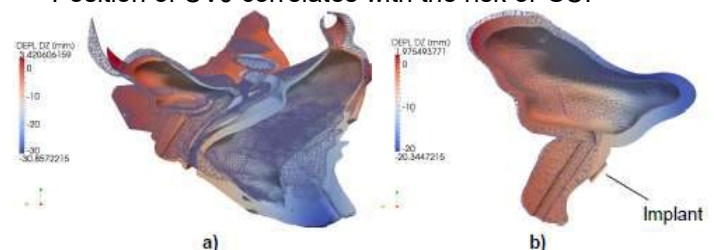- Choosing of mid-proximal position to resist against urethro-vesical junction (UVJ) movement
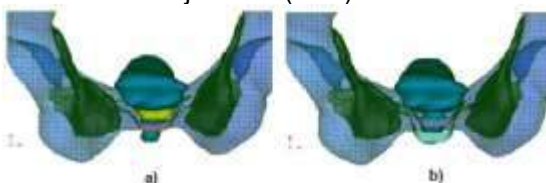
Possible position of the prosthetic meshes.
a) proximal, b) mid-urethral

– Result –

Stress Urinary Incontinence

- Position of UVJ correlates with the risk of SUI

Distribution of deflection in a PUL
a) with 80 % impairment,
b) with implant. Wireframe models are in healthy state

- Vertical movement of the UVJ during straining
  - 4,8 mm : healthy
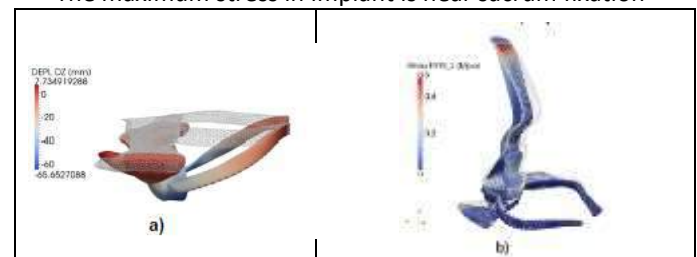 - 8.5 mm: 80% impairment
  - 8.02 mm : reconstructed
- Maximum principle stresses in the implant

$$\sigma^{zz}_{max}: 2.51 \text{ MPa}$$

Stress distribution on the implant

Uterine Prolapse

- Constrained movement of the uterus due to sacrocolcopexy : 12,08 mm versus 65,65 mm
- The maximum stress in implant is near sacrum fixation

a) Uterus displacement due to weak apical support
b) Stress distribution on the mesh implant

- Conclusion -

- Urethro-vesical junction can be uplifted using mesh implant to help SUI problem.
- Cervical-ring suspension can be reduced using the mesh implant
- Stress distributions on adjacent tissues need to be investigated

Applications submitted by members

Code_Aster and non-conventional civil engineering structures : Cross laminated timber buildings

Ioannis P. CHRISTOVALIS – Lorenzo RIPARBELLI – aether Engineering - Italy   www.aethereng.com
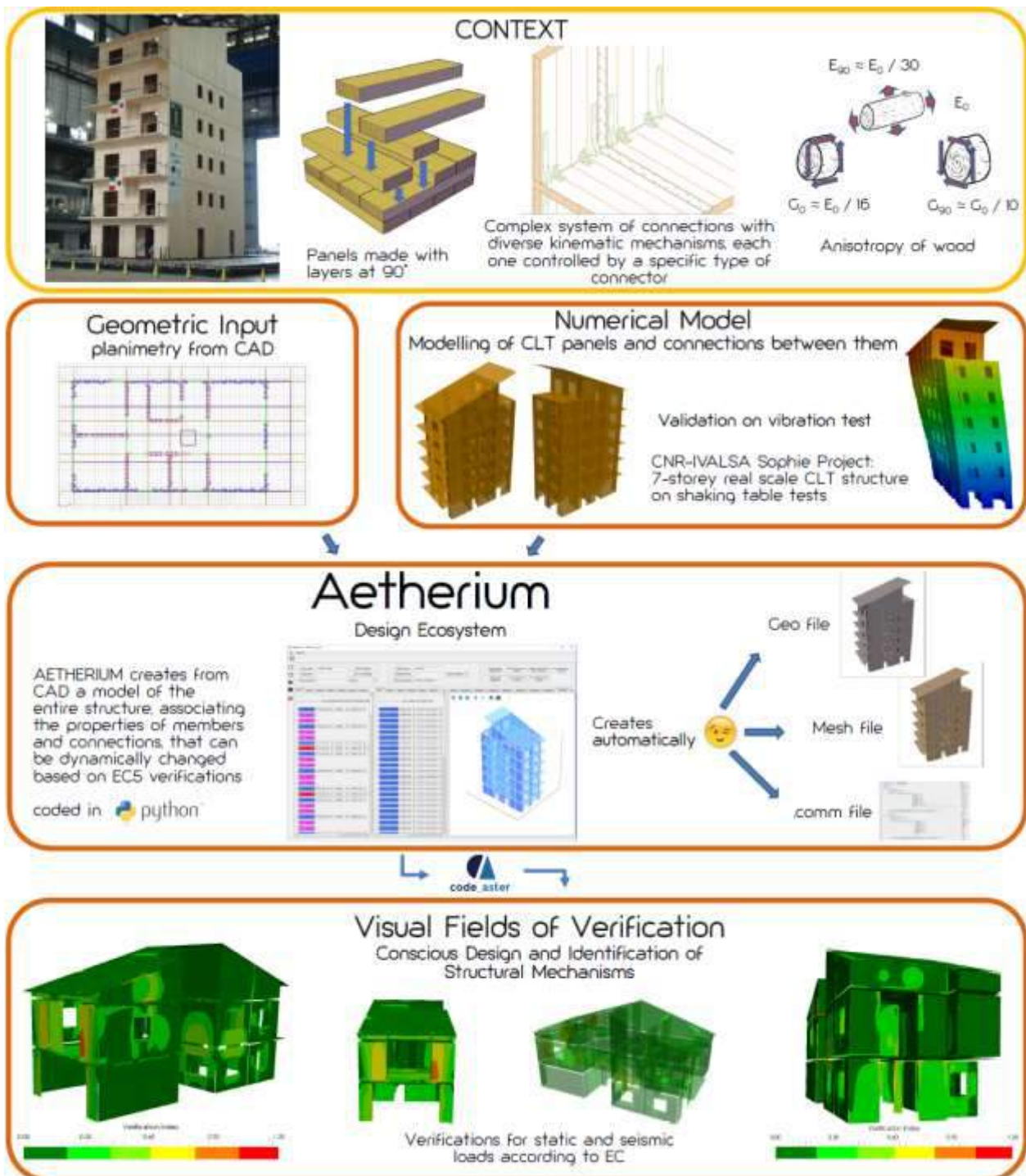
QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK

Applications submitted by members

Code_Aster and non-conventional civil engineering structures :
Masonry buildings

Michele BETTI, Vladimir Cerisano KOVAČEVIĆ, Riccardo CORAZZI,
Luca FACCHINI, Gianni BARTOLI
DICEA (Università di Firenze), Kobe Engineering – Italy

UNIVERSITÀ DEGLI STUDI FIRENZE   kobe

Project knowledge transfer from research to application

Validation of damage based constitutive models (Mazars) for masonry-type structures [2012]

To validate the use of a concrete damage based constitutive law for masonry applications, data from diagonal tests and earthquake shaking table tests were considered (T.R.E.M.A. project – 2008).

The comparison between experimental data and numerical results, together with and the damage pattern allows for a reliable use of the homogenized approach for a «textured» material.

Betti M., Bartoli G., Corazzi R., Kovačević V. (2012). Strumenti Open Source per l'ingegneria strutturale. Modellazione meccanica non lineare di edifici in muratura. Bollettino Ingegneri, Collegio Ingegneri della Toscana, LX (12), 3-15.
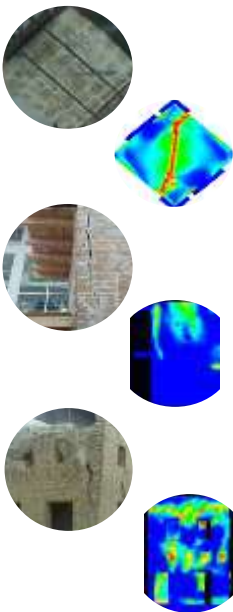
Identification of damage causes in a Renaissance Italian palace through nonlinear analysis [2013]

Palazzo Bourbon Del Monte in Piancastagnaio, Tuscany, exhibits a severe and variegated vertical and horizontal cracking pattern. Due to the damage and the consequent structural risk, the palace was evacuated during the '80s.

After the installation of a monitoring system and several in situ tests, a *Code_Aster* nonlinear model was employed to look for an interpretation of the manifested damage.

The results allowed an extensive comprehension of the causes of the damage pattern, which were found in the ground instability and water pore pressure changes.

Nonlinear dynamic analysis of masonry towers and tower-like structures, RiSET project [2016]

A seismic vulnerability campaign was initiated on different types of masonry tower structures, including the Torre del Mangia in Siena. After a study on the reliability of different nonlinear constitutive laws for cyclic loading in masonry modeling, the ENDO_ORTH_BETON model was chosen to perform nonlinear dynamic analyses on the towers, revealing a great sensibility of higher vibrating modes for slender elements and in the colapse progression of stiffer structures.

Bartoli G., Betti M., Vignoli A. A numerical study on seismic risk assessment of historic masonry
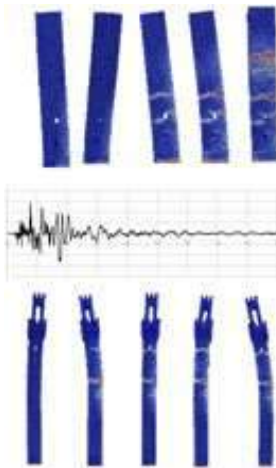
Dynamic vibration modes identification on Michelangelo's David in comparison with experimental data [2015]

Every year about a million and a half tourists visit the Michelangelo's David in the Accademia Gallery in Florence (Italy). Such a large number (about four thousand people each opening day) motivated in the last few years several concerns. After a two day monitoring with a interferometric radar, a numerical model of the statue was built based on a laser scanner geometrical survey and subsequently employed to evaluate the experimental results.

Pieraccini M., Betti M., Forcellini D., Devis D., Papi F., Bartoli G., Facchini

Applications submitted by members

Code_Aster in simulation Based Research & Development Services
Łukasz MACIEJEWSKI – NOBO Solutions – Poland

Nobo solutions

Power Generation

Rotordynamics

Code_Aster as a fundamental tool allows Nobo Solutions to offer a broad scope of rotor dynamics analyses for new and retrofitted rotors for conventional and nuclear turbogenerators applications. The analyses include static deflection, critical speeds and mode shape forms, torsional vibrations, n-alpha diagrams and more.
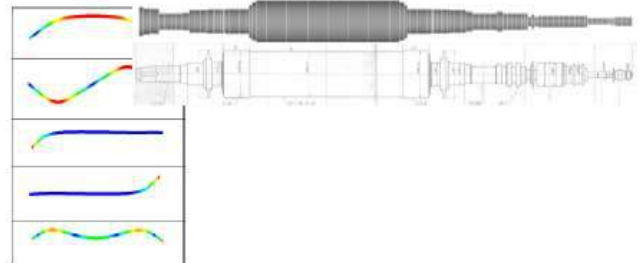
Structural Integrity

State of the art material models and element formulations in Code_Aster is an important tool for Nobo Solutions in projects where comprehensive structural integrity studies are required. Nobo Solutions expertise in fatigue, fracture and structural dynamics is supported by proven and reliable FE solver. Stress and strain fields results obtained for relevant load cases are further used in life-time assessments in in-house developed engineering tools.
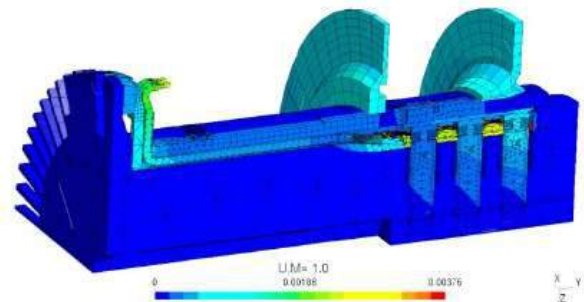
Civil Engineering

Composite Materials

For the purpose of a new civil engineering concrete, steel reinforced component mechanical and thermal numerical simulations in Code_Aster were performed. Two constitutive models i.e. Double Drucker-Prager (BETON_DOUBLE_DP) and a model for the anisotropic damage (ENDO_ORTH_BETON) were employed. Both of them gave satisfactory results confirmed by experimental testing. Finally, BETON_DOUBLE_DP was chosen because of its capability to change of properties in dependence of increasing/decreasing thermal load.

www.nobosolutions.com

QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK
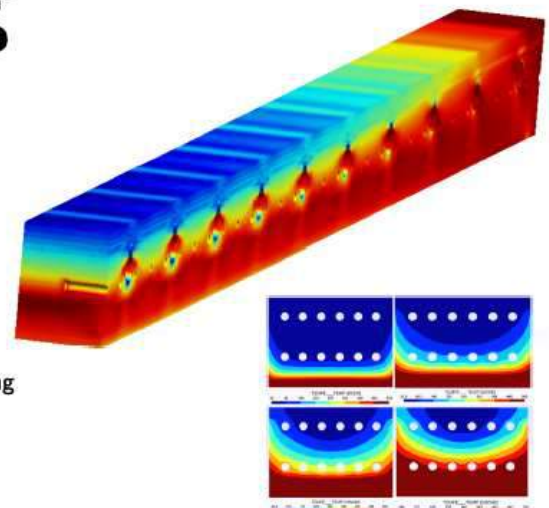
Applications submitted by members

Richard SZOEKE-SCHULLER – SIMSCALE – Germany

INDUSTRIAL APPLICATION EXAMPLES

The team at Malaika tested the primary ISOfix of world's first Range of child car seatsthat will surpass every international Safety standard with SimScale.
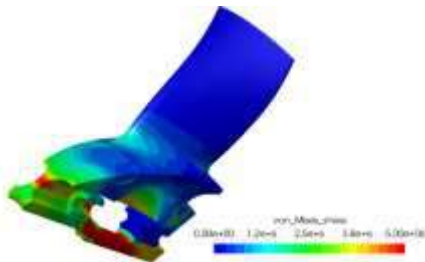
A static linear analysis was performed with **Code_Aster** on **SimScale** to test the worst case scenario at a force of 3600 N on the bar. The bar and rail were bonded together whereas a sliding contact was defined between the teeth. With a mesh of nearly 360K nodes, it took under 20 min. to complete the simulation on an 8 coremachine.

The outcome on the right shows that a small region under teeth has reached the yield point of steel. This allows engineers at Malaika to decide over a design change in order to avoid catastrophic failure duringcrash.

The team at Schübeler analyzed the stress acting on a turbomachinery blade made out of composite materials for model planes using SimScale.

A static nonlinear analysis was performed with **Code_Aster** on **SimScale** to analyze the stresses in a turbomachinery blade rotating at nearly 50 000 rounds per minute. To analyze the actual behavior, physical contacts were defined between blade, ring and axis. With a mesh of nearly 95 K nodes, it only took 21 min. to complete the simulation on 32 coremachine

COMMUNITY EXAMPLES

On the **SimScale** community more than 80.000 engineers, professionals, students, hobbyists are using **Code_Aster** to simulate real world problems. Until now, there are around 6000 public projects performed using **Code_Aster** on **SimScale**.

Some of the finished projects from different community users are shown in the right figure that include projects using static, dynamic, thermal and thermo- mechanical solvers.

The complexity of the projects performed daily on **SimScale** shows the true usability of **Code_Aster** in solving problems that may belong to automotive, aerospace, oil & gas, electronics or construction industry without the premise of expert knowledge related to the specificities of the solver.
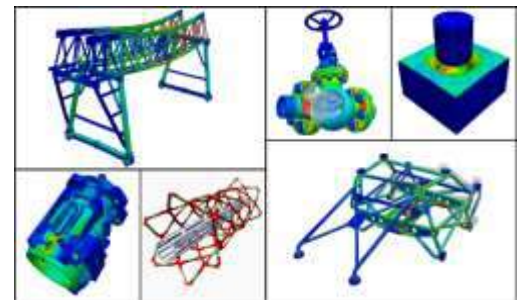
ACADEMIC EXAMPLES
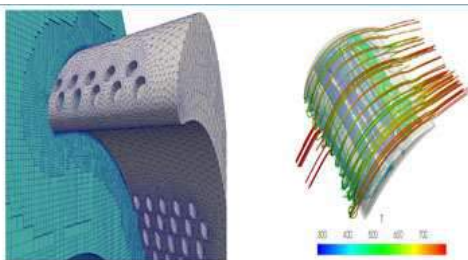
In the course of a master thesis in a collaboration with TU Hamburg-Harburg and TU München, a structural optimization algortihm was developed based on the Level Set Method in conjunction with the XFEM functionality provided already within **Code_Aster**. Project OGACA, developed by Frédéric Renou, formed the initial starting point. Results showed a very good convergence speed as well as a good performance of the final shape compared to literature as well as results of commercially available tools

In a second master thesis work a partitioned approach to perform conjugate heat transfer analysis was developed. The coupling was done with the multiphysics coupling library preCICE using OpenFOAM and **Code_Aster** solvers to handle the fluid and structural domain respectively.

ProNet UPDATE - 6

Industrial and research centers, services providers and teachers are welcome

75 members - 17 countries

aether ENGINEERING	AIRBUS GROUP	alneos	ANDRITZ Hydro	B.Ing Ingénierie-Etudes-Calcul EF	BC BISCARRI CONSULTORIA	ILE-DE-FRANCE
Italy	**France**	**France**	**Switzerland**	**France**	**Spain**	**France**
CAE Linux	Cerema	CEVAA	coperion k-TRON	CRIANN	DeltaCAD	Centre R&D de mikado DINCCS
Switzerland	**France**	**France**	**Switzerland**	**France**	**France**	**France**
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France	**UK**	**France**	**France**	**France**	**Czech Republic**	**France**
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Germany	**Canada**	**Spain**	**France**	**France**	**Germany**	**France**
Imperial College London	Dr.-Ing. J. Ackva Ingenieurbüro für Mechanik	Ingenieurbüro Vorsteher & Partner	INGÉROP	KISTI	kobe	
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LafargeHolcim	LaMCoS UMR 5259	Logilab	MaSC MANCHESTER	sixense Necs	Nesys	Nobo solutions
France	**France**	**France**	**UK**	**France**	**France**	**Poland**
nrctech	PERMASWAGE	PHIMECA	ROLEX	SIMSCALE	STABILIS	TECSIMAT Technology Simulation Material
Switzerland	**France**	**France**	**Switzerland**	**Germany**	**France**	**Spain**
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France	**France**	**Japan**	**France**	**Poland**	**France**	**Germany**
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Germany	**Canada**	**Germany**	**Mexico**	**China**	**France**	**Canada**
RĪGAS TEHNISKĀ UNIVERSITĀTE	HOCHSCHULE MÜNCHEN	TECHNISCHE UNIVERSITÄT KAISERSLAUTERN	UNIVERSIDAD DEL BIO-BIO	UNIVERSITÉ DE TLEMCEN		
Latvia	**Germany**	**Germany**	**Chile**	**Algeria**		