Finite Element Analysis
Simulation, Support & Training
CODE-ASTER, FEMAP, NASTRAN

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# Code-Aster Courses at Ingenieurbüro für Mechanik

This is an overview of the *Code-Aster* courses offered by the Ingenieurbüro für Mechanik. The courses are organized Inhouse (in your company, for your simulation team) or as group courses.

Any courses or subjects *not* covered by the below-named courses or blocks can be offered as an individual seminar. Or it can be introduced via a project case in your company.

If you have any questions or interest in a course don't hesitate to contact us at the phone or mail adress given above.

# Contents



# 1 Code-Aster Standard Courses

These are our standard seminar. Each of them is a line in the table with the content blocks and the (recommended) duration:

| Course Title | #days | content blocks | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Code-Aster Introduction | 5-6 | Linux | PrePo | Study | Solid | Struc | Cont | NonliM | |
| Code-Aster QuickStart | 3-4 | Linux | PrePo | Study | Solid | | Cont | | |
| Code-Aster Dynamics | 2 | | | | | | | | Dyn |
| Code-Aster Thermal | 2 | | PrePo | | | | | Ther | |
| Syrthes Thermal | 2-3 | | PrePo | | | | Ther | Syr | |
| Pre-/Post | 2 | | PrePo | | | | | | |

# 2 Content Blocks of the Courses

The courses are comprised of certain topical *content blocks*. Each block is seperatly treated with it's own learning material (presentations and/or exercises, example files etc.). This method has been well-proven in our $>15$ years experience in teaching Finite-Element methods, and in particular *Code-Aster* and related useful and complementary tools.

The blocks are listed in the table below. The table is followed by the content descriptions.

| Short Block Title | Block Title |
|---|---|
| Linux | Linux & Code-Aster tools |
| PrePo | Pre- and Postprocessing (Salome & ParaVis) |
| Study | AsterStudy |
| Solid | Code-Aster Solid Models |
| Struc | Code-Aster Structural Models |
| Cont | Contact |
| NonliM | Nonlinear Materials |
| Dyn | Dynamics |
| Ther | Thermal Analysis |
| Syr | Syrthes - Thermal Analysis |

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## Linux & Code-Aster tools

This initial block is intended to smooth contingent initial problems with Linux and the Linux shell. It should help to concentrate better on *Code-Aster* during the course.
The content is:

- Most basic Linux commands
- Starting *Code-Aster* and it's tools from the Linux shell (*Salome*, *gmsh*, *astk*, *Code-Aster*, *editor*, ...)
- Configuration of the Linux shell (alias)
- if needed: solving installation problems

Duration: 0 - 1/4 days

## Pre- and Postprocessing (Salome & ParaVis)

This block can vary between 1/2 - 2 days because it depends much on the participants' existing experience with CAD modeling, meshing, Postprocessing, and eventually with *ParaView*.
Geometry and Meshing with Salome:

- Importing and/or creating/manipulating geometry
- Importing and/or creating/manipulating and exporting meshes
- Grouping nodes and elements

Postprocessing with ParaVis (ParaView as a Plugin of Salome):

- Mesh-Visualisation
- Postprocessing: contour, warped, glyph plots, animations, grouping etc.

Duration: 1/2 - 2 days

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## AsterStudy

AsterStudy is the module in SalomeMeca (since version 2017) which handles the preparation, running etc. of a Code-Aster study, by controling any resources, interfacing the mesh(es) with the command-file(s), scheduling analysis steps etc. We will work along a tutorial to explore AsterStudy.

Duration: 1/2 days

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## Code-Aster Solid Models

This block is the "nucleus" of a *Code-Aster* introduction. It is all we must know if we do not care about Pre- and Postprocessing and prescind from more advanced analysis topics.

- Code-Aster files
- Syntax of mesh and command file
- User documentation system
- node and element groups
- Code-Aster command editor *eficas* (for version $\leq 13.3$)
- Code-Aster command job run platform *astk* (for version $\leq 13.3$)
- Code-Aster concepts (*Maillage*, *Modele*, *Champ*, *Resultat*, *Table* etc.)
- Solid element types (3D, axialsymmetric, plane strain, plane stress)
- Discret elements
- Load and boundary conditions, linkages between degrees of freedom
- Materials
- Continuation run (*POURSUITE*)
- Mesh refinement (*HOMARD*)

Duration: $1\frac{1}{2}$ - 2 days

## Code-Aster Structural Models

This is the complement to the block about Solid models.
We learn how to model structural elements such as plates, shells, beams, discret elements.

- Structural elements: plates, shells, beams, discret elements
- Element characteristics
- Visualization of element characteristics
- Local coordinate systems
- Load and boundary conditions
- Linkages between structural and between solid and structural elements
- Output over plate thickness (for example stress at top and bottom fiber)
- Stress output coordinate system
- element offset

Duration: 1/2 - 1 days

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## Contact

- Definition of contact
- How to setup a nonlinear analysis: time stepping, load incrementing, convergence, ...
- Aspects of contact: "thickening" of contact surface, shrinkfit, "weak springs method" for bodies with no constraints but in contact, contact output
- Creating tables, functions and diagramms in a Postprocessing run (POURSUITE run)

Duration: 1 days

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## Nonlinear Materials

- Definition of material behaviours
- How to setup a nonlinear analysis: time stepping, load incrementing, material behaviours, convergence, ...
- Examples: Elastoplastic, creep, hyperelastic material. Temperature dependent material.
- Creating tables, functions and diagramms in a Postprocessing run (POURSUITE run)

Duration: 1 days

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## Dynamics

- Theory background: Dynamic equations of motion and their solution
- Real and complex modal analysis
- Modal parameters, normalization of modes, filtering modes, ...
- Modal reduction
- Concepts of Damping: viscous/structural damping, discret dampers, Rayleigh-damping, Hysteretic damping, Modal damping. Interpretation for the 1-degree-of-freedom and the multi-degree-of-freedom system
- Frequency analysis, direct or with modal reduction
- Transient analysis, direct or with modal reduction
- Base point acceleration

Duration: 2 days

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## Thermal Analysis

- Analogy between thermal and mechanical analyis
- thermal solid and plate elements
- thermal loads (sources, convection, radiation, ...
- thermal analysis: steady state and transien
- Postprocessing and visualization: temperature, heat flux
- Mapping temperatur fields as load input on a mechanical model, to calculate thermal strain and to evaluate temperature-dependent mechanical material properties, ...

Duration: 1 - 2 days

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## Syrthes - Thermal Analysis

*Syrthes* is a Finite-Element program, developed by *EDF*, for (and limited to) thermal analyses. It is richer than *Code-Aster* insofar it can also take into account radiation enclosures, symmetry conditions related to radiation, and heat transport through mass transport. It is simpler insofar only solid elements are supported. A good way to work with *Syrthes* is to couple it with *Salome* and *Code-Aster* for the Preprocessing (meshing, creation of groups, ...) and for the Postprocessing. Thermal (*Syrthes*) and mechanical (*Code-Aster*) analyses can be done in sequences.

- Preprocessing (Meshing with *Salome*, Creation of groups), transfer to *syrthes* mesh format
- *Syrthes* command file
- Analysis
- Postprocessing

Duration: 2 - 3 days