Author: Lorenzo Gracia

FINAL REPORT OF INDSUTRIAL TRAINING

My industrial training has been performed in CIMNE, from 01/10/2015 to 31/12/2015. The main tasks that I have developed during this time are the following:

- Benchmarking of the Solid Mechanics Application (Linear Elasticity)
- Detection and reparation of 20 nodes Hexahedron
- Detection of errors in writing files of the Solid Mechanics Application
- Creation of Dam Application (Kratos)

In the next lines I am going to explain in more detail in what consist on each one of the tasks to understand in better way the performed work.

Benchmarking of the Solid Mechanics Application (Linear Elasticity)

A benchmarking of the Solid Mechanics Application has been carried out. To check if the code works properly, benchmarking are a must. In this case, the study in focused in Linear Elasticity and the used element is small displacements, only remark that for the last benchmark also have been carried out an analysis of large displacements.

The idea with these benchmarks is to compare the obtained results using the proposed software with the obtained by other software (RamSeries or Abaqus).

In all performed benchmarks have been checked the different typologies of elements, linear and quadratics, for 2D and 3D.

The following cases have been performed;

- Thin plate under axial load
- Thin plate under dead weight
- Beam under point load
- Flexion of 3D beam
- Z Cantilever

The results have been successful and also a useful way to detect some errors in the code and in the interface as well. Only comment that this application has a huge range of typologies of analysis as can be plates and shells, and not all the possibilities were still available, due to this reason the benchmarks are only focused in Plane Stress /Strain 2D, Beams and Solids.

Detection and reparation of 20 nodes Hexahedron

Thanks to the performed benchmarking, an error in the code of the 20-node Hexahedron has been detected. The problem was that when the problem starting to run, a warning window appeared, giving information about that the Jacobian is negative. This problem led to that the computations were not possible with this element.

The reparation of this element was a challenge for me, since the code was a stranger for me. At the beginning was difficult, since the code is written in C, and during the master course, this language is rarely mentioned (I think in some subjects would be interesting the use of this language). After some time was possible to detect that the problem came from the bad assignation of the shape functions and its derivatives. Also was detected that the factors for the lumped mass matrix were wrong. These factors were computed and replaced the correct ones by the wrong ones.

Detection of errors in writing files of the Solid Mechanics Application

The performed benchmarks were a useful help to detect some error in the writing files .mdpa (model part). This file contains the information of the problem as can be; the nodes of the mesh, the connectivities and the boundary conditions of the problem.

Also was detected other errors in files as; materials.py, related with the material properties, and ProjectParameters.py, which contains the information of the used solver, the time step...

Creation of Dam Application (Kratos)

After carrying out the benchmarking and the correction of the detected errors in the Solid Mechanics Application, the Dam Application was created.

This application is developed with the aim of dam computations. In this application the idea is giving the possibility to carry out thermal-mechanics computations.

I am going to comment some details about this application that is still in development but currently is working. The main idea is to merge the mechanical problem and the thermal problem. To do that we use some parts of the existing applications in the Kratos repository.

The thermo-mechanical problem is uncoupled, this means that first, the thermal problem is computed and after the thermal contribution is added to the mechanical problem thanks to a modification in the constitutive law.

To solve the thermal problem we use the Convection-Diffusion application, vanishing the corresponding part to the convection, since we only want to solve a diffusive problem. To make stable the problem was necessary to use a Backward Euler scheme for the time discretization. The computations related to the mechanical part are solved using the linear elastic law from Solid Mechanics Application, making some modifications.

Since our interest is to solve dam problems, was necessary the implementation of new types of boundary conditions, hydrostatic pressure and the Bofang formulation (which provides the temperature inside of the reservoir depending the level in which we are and some thermal parameters that are input parameters for the problem).

Also was created a new element to give the possibility of drawing in the post process, the different contributions related to the thermal problem and the mechanical problem.

As a future work, the idea is to develope the possibility to introduce the variation of level water depending the time of the year and see how this affect to the body dam. Other further improvement is start the computations for non-linear case.

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Signed: Lorenzo Gracia Llinares