

# Instructions, how to use `SimControl.m` and Input Files:

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## 1 Introduction

This document describes, how the control routine `SimControl` works and what it is good for. In addition, it explains how you can set up your own examples.

## 2 SimControl

### 2.1 Used modules

The routine `SimControl` controls the work flow in an xfem-computation. First, a brief overview of the used modules.

#### 2.1.1 `comp_geo`

`comp_geo` generates the background mesh. Input parameters for this module are saved in `xfeminputdata_comp_geo.mat`. The parameters are:

<code>IFmeshstructure</code>	mesh structure
<code>IFshapegeometryID</code>	shape of geometry
<code>IFlength</code>	length of rectangle
<code>IFheight</code>	height of rectangle
<code>IFnldivx</code>	number of elements in x-direction
<code>IFnldivy</code>	number of elements in y-direction
<code>IFdatasetp</code>	dataset for matrix <code>p</code> (contains coords of centroid of grains)

Different matrices `p` are stored in `comp_geo\vdata_multi.m`. The main routine of `comp_geo` is `main_comp_geo.m`. The results (mesh data) are saved to the file `my_new_mesh.mat`. The result file has to be copied and pasted to the `preprocess` directory.

#### 2.1.2 `preprocess`

The main routine `main_preprocess.m` manages the appliance of Dirichlet and Neumann Boundary Conditions (DBC and NBC) and assigns material properties to each element. Input data are load from `xfeminputdata_preprocess.mat`. These parameters are:

IFDirichletBCs	ID for a set of DBCs
IFNeumannBCs	ID for a set of NBCs
IFMatSet	ID for a set of material properties

The mesh `my_new_mesh.mat` is load, too. The boundary conditions are stored in separate files for each kind and each example, located in the folder `preprocess\Boundary_Conditions`. The material data are stored in `MaterialProperties.m`.

Results of this routine are stored to `my_new_mesh_with_BCs.mat`. The result file has to be copied and pasted to the XFEM directory.

### 2.1.3 XFEM

The main routine `main_xfem.m` manages the assembly and solution process. Some preprocessing is done, too. Input data is load from `xfeminputdata_xfem.mat`. These parameters are:

IFsliding_switch	indicates, wheter and which kind of sliding is admitted
IFSolverType	explicit (0) or implicit (1) solver
IFmaxiter	maximum number of iterations for implicit solver
IFconvtol	convergenz criteria for implicit solver

The mesh with boundary conditions (`my_new_mesh_with_BCs.mat`) is load, too. After the computation, you can run some scripts to visualize the results: `showmesh.m`, `showdeform.m`, `showdeform2.m`, `xx_stress.m`

## 2.2 Operating mode of `SimControl.m`

`SimControl.m` initializes some variabeles to specify the example, which has to be solved, and then calls the three routines `main_comp_geo.m`, `main_preprocess.m` and `main_xfem.m` in sequence. It also manages the copying process of the result files between the subdirectories. You can specify, which of the three modules shall be executed. Perhaps, you do not want to run the background mesh generation each time, when you only changed some boundary conditions.

To choose the example, you want to solve, you have to give the filename of the appropriate input file to the variable `filename_input_file` without the file extension `.m`. To start the simulation, the current working directory has to be the one, in which `SimControl.m` is saved. Just run the script `SimControl.m` to start the computation.

### 3 Input Files

The data to define the examples and the code to solve the examples are quite separated. The databases are included in the code, the selection of the data is outsourced to the input file.

Input files are scripts, that initialize some variables, which configure your example. A full list and description of these variables and IDs can be found in `InputFileRoutine.m`.

Important: Always start a new example in `InputFileRoutine.m`, so that the ID list is always up-to-date in this file.

To set up a new example, open `InputFileRoutine.m` and configure all IDs the way, you want (Remark: Input parameter names are indicated with `IF` at the beginning of the variable's name.). After setting the parameters, do not forget to update the databases, from which data shall be load. These database are

a) `preprocess\MaterialProperties.m`

Add additional cases to the switch-case-structure.

b) `preprocess\applybcs.m`

Add additional cases to the switch-case-structures for DBCs and NBCs.

c) `preprocess\Boundary_Conditions`

Make new files for DBCs and NBCs. Indicate them with an appropriate file name and the ending `_DBC.m` or `_NBC.m`.

After running a first simulation with the input file `InputFileRoutine.m` to check, if it works properly, saved it as `inp_NAME#_MSHX_MSHY.m`, where `NAME` is the name of the example, `#` is a number, `MSHX` is the number of elements in x-direction and `MSHY` is the number of elements in y-direction. Save this file to the same directory as the control routine `SimControl.m`.

Now, you can run this example by choosing its file name in the `SimControl` variable `filename_input_file`.