



IMPACT* Module for *Elmer

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1 *Elmer*

In order to build a module for *Elmer* it is necessary to download and build *Elmer* from the source. Information regarding accessing the source code can be found at <https://www.csc.fi/web/elmer/sources-and-compilation>. The module build uses the *CMake* capabilities provided with *Elmer* so when building *Elmer* be sure to use these instead of the auto-configure tools. It is recommended that you first build *Elmer* without the module and ensure that it works properly before attempting to build the basic module. Make sure that you run `make install` when building *Elmer* to have access to the necessary libraries built by *Elmer*.

For those working from within Illinois Rocstar, after building *Elmer* with *CMake* you can test it using the documentation provided in Section 4.3 and 4.4 of Uniphysics Validation for Development of Multiphysics Coupling in MP-Infra which can be found in svn under `svn://irsvn/SourceRepository /MPInfra/data/documentation/validation_uniphysics/Tex`. You can run the example using the *Elmer* that has been installed on `/Projects` (following the directions from the guide) and compare that to the results from running your installation of *Elmer*.

Note: if you use the *Elmer* module mentioned in the guide be sure to reset your environment variables appropriately when running your installation of *Elmer*. Otherwise, you may simply be using the *Elmer* on `\Projects` again.

In order to run your installation of *Elmer* ensure that your environment variables `PATH`, `LD_LIBRARY_PATH`, `ELMER_HOME`, and `ELMER_LIB` are set to the locations of your *Elmer* executable (for `PATH` and `ELMER_HOME`) and your *Elmer* libraries (for `LD_LIBRARY_PATH` and `ELMER_LIB`). Note that *Elmer* may install some libraries in a directory titled `share` and some in a directory titled `lib` so be sure all libraries are accessible.

IMPORTANT: also note that when using the *CMake* build of *Elmer* you will likely be unable to use the GUI version of *Elmer* and may need to replace the command `ElmerSolver` (shown in the IR Uniphysics Validation document) with `ElmerSolver_mpi`.

Examine your *Elmer* installation directory to see what is available. After ensuring that the test run works, the next steps toward building a module can be taken.

2 *IMPACT*

The Illinois Rocstar software *IMPACT* is required for integrating the *IcoFoam* module. For an external user the *IMPACT* software may be downloaded from <http://sourceforge.net/p/openmultiphys/wiki/Consortium%20for%20Open%20Multiphysics/>. For an internal user, *IMPACT* is located in the repository under `IMPACT/trunk`. Follow the build instructions from the User's Guide. Note that internal users may not need to build *IMPACT* but instead simply load the *IMPACT* module provided to their machine.

Ensure that the locations of the *IMPACT* `include` and `lib` directories are known since they will be needed in Section 3. If you use `make install` when installing *IMPACT* these directories

should both be located under the install directory. Otherwise, they should be located in the main source directory and the main build directory for *IMPACT* respectively.

3 Obtaining, placing, and editing the module files

For a user internal to Illinois Rocstar the files necessary for building a module for *Elmer* can be found in the source repository under `svn://irsvn/SourceRepository/MPIinfra/Third_Party_Modules/ElmerTest/trunk`. For an external user these files may be found on the open multiphysics website (to come). The files will contain the appropriate directory structure for building the driver. However, the files used with *Elmer* to create a module library must be placed in the appropriate locations within the *Elmer* source files in order for them to build. These files are located under the `native` directory of the module main source directory. The locations for placing these files will be given, but it should be noted that these are specific for *Elmer 7.0*. In the case of another version of *Elmer*, it may be necessary to place these files in different locations. If you are using a different version of *Elmer*, it is suggested that you locate the source file `Solver.src` and then place the module files in a manner with a similar structure to that shown here.

All paths below are shown from within the *Elmer* main source directory.

- The main source file `Solver.src` should be located under `fem/src`.
- Place `SolverModuleHeader.H`, `SolverModule.src`, and `ModTestObject.f90` in `fem/src`.
- Add the contents from `CMakeLists_Additions.txt` to the bottom of the `CMakeLists.txt` file in `fem/src`.

The module files are now in place and `CMakeLists.txt` edited, so the module library can be built.

4 Building the module library and driver

In order to build the *Elmer* module library, simply repeat the build steps taken when building *Elmer* for the first time (see [Section 1](#)). However, now *Elmer* will require the *IMPACT* libraries for the build since the new source files added for the module require them. If you installed *IMPACT* in a non-standard location you will need to specify the location of the *IMPACT* libraries for *CMake*. After the building completes, ensure that the *Elmer* module library built; it is entitled `libSolverModule.so`. It should be located under the `lib` directory of the *Elmer* installation (be sure to run `make install`).

If the library built successfully, the driver for the module may now be built and linked to both *IMPACT* and the module library. It is recommended that the driver source and build files be kept in separate directories from one another and from *Elmer*. The build steps are as follows:

- Create a build directory for the driver.
Example:

```
> mkdir /home/user/ElmerModuleBuild
```
- Change directories to the build directory.
Example:

```
> cd /home/user/ElmerModuleBuild
```
- Run *CMake* on the module driver source directory with the `CMAKE_PREFIX_PATH` set to both the *IMPACT* install location (or locations of the *IMPACT* bin and lib directories) and the directory containing the *Elmer* installation (or the location of the *Elmer* lib directory).
Example:

```
> cmake -DCMAKE_PREFIX_PATH=/home/user/IMPACT-install\;  
/home/user/elmer-install /home/user/ElmerModule
```

(**Note** that there is no space between `\;` and `/home/user/elmer-install`. The new line shown above is used only for visual clarity.)
- Run `make` and, if desired, `make install`.

Note that *Elmer* may install more libraries in the installation directory under `share/elmersolver/lib/`. You can either create a soft link to these libraries in the `elmer-install/lib` or you can include this directory in the `CMAKE_PREFIX_PATH` by appending it after another `\;` in the `cmake` command shown above.

Once the build process has finished ensure that the module driver built by checking the `bin` directory within the module driver build directory for `SolverModuleDriver`.

5 Runing and testing the *IcoFoam* module

Now that the library and driver for the module have been built, run the driver executable in the same manner in which *Elmer* was run in the example problem discussed in Section 4.3 and 4.4 of the Uniphysics Validation for Development of Multiphysics Coupling in MP-Infra document (mentioned in [Section 1](#)). **Note:** Remember to double check your environment variables. Ensure that the module driver achieves the same results as using the initial *Elmer* executable. [Figure 5.1](#) shows the results of the simulation.

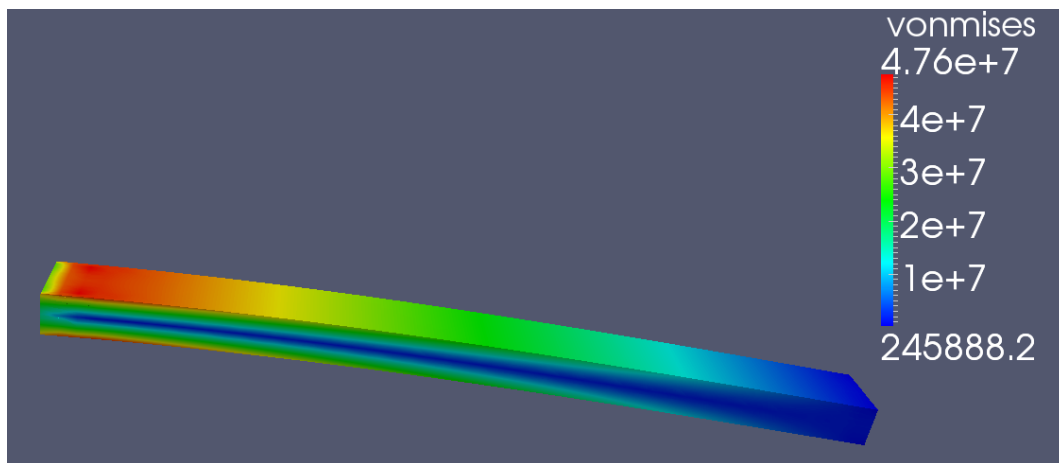


Figure 5.1: Results of elastic beam example run with *Elmer IMPACT* module