Putting New Physics into *Albany*

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April 13, 2015

This document describes the key steps to putting in a new problem with a new set of physics (PDEs) into the *Albany* code base.

1. Obtain and build TPLs required for *Trilinos* (HDF5, Netcdf, Boost), *Trilinos* and *Albany* (see instructions on the *Albany* WiKi: `https://github.com/gahansen/Albany/wiki/Building-Albany-and-supporting-https://github.com/gahansen/Albany/wiki/Building-the-new-Albany`).

2. Find a problem in *Albany* that is similar to your problem (e.g., similar PDEs, same # dofs/node, etc.). Lets say the problem you find is has the name "Original Problem" with evaluators `problems/OrigProblem.hpp`, `problems/OrigProblem.cpp`, `evaluators/OrigProblemResid.hpp`, `evaluators/OrigProblemResid_Def.hpp`, `evaluators/OrigProblemResid.cpp`.

3. Lets say you want to create a problem called "New Problem". First, copy the following:

   - `cd Albany/src/problems`
     `cp OrigProblem.hpp NewProblem.hpp`
     `cp OrigProblem.cpp NewProblem.cpp`.
   - `cd Albany/src/evaluators`
     `cp OrigProblemResid.hpp NewProblemResid.hpp`
     `cp OrigProblemResid.cpp NewProblemResid.cpp`
     `cp OrigProblemResid_Def.hpp NewProblemResid_Def.hpp`.
   - `cd Albany/examples`
     `mkdir NewProblem`
     `cd NewProblem`
     `cp ../OldProblem/CMakeLists.txt .`
     `cp ../OldProblem/input*.xml .`

4. Rename the classes in the new files under `Albany/src/problems` and `Albany/src/evaluators`.

5. Edit `CMakeLists.txt` and `examples/NewProblem` to add new files and directories that have just been created.

6. Edit `Albany/src/problems/Albany_ProblemFactory.cpp` to add your new method and a constructor for it, e.g.,

```
else if (method == "New Problem")
strategy = rcp(new Albany::NewProblem(problemParams, paramLib));
```

7. Edit `Albany/src/examples/NewProblem/input*.xml` files, changing "Problem" name to "New Problem".

8. Clean up NewProblem files in `Albany/src/evaluators` and `Albany/src/problems` – remove extraneous stuff, change # dofs per node, if necessary. You may need to add dependencies, but this can be done at a later time.

9. Put your new PDEs (weak for of the residual) in `NewProblemResid_Def.hpp`.

10. You may want to write additional evaluators for some of the terms in the PDEs, e.g., viscosity, source term, etc.

11. Edit `Albany/src/examples/NewProblem/input*.xml` files to specify your desired initial conditions, boundary conditions and mesh ("Dirichlet BCs", "Neumann BCs", "Discretization" sections). Also specify any parameters, if applicable. Change the solver, if applicable/desired.