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## An Introduction to Linear Solvers in OpenFOAM

In this tutorial we will explore different linear solvers, their properties and scaling behaviour. Most of the settings we will discuss can be found in the 'system/fvSolutions' file of your case.

## Exercise 1:

- Make a copy of your testCase
- Use the 'banana' method to find all available solvers for the pressure equation **p**;
- Do the same for preconditioners of **p**;
- Which solvers and preconditioners do you recognize?
- Do the above steps for U, how do solvers and preconditioners for U and p differ, and why?

## Exercise 2:

- Apply the following settings to your test case
  - $\circ$  Set endTime to 1.0
  - $\circ$  Set writeIntervall to 10000; // we don't want to write anything to disk
- Set the following preconditioner 'none', 'DIC', 'diagonal' for the pressure equation, run the test case. Note how long the solver needs to finish, and how many iterations are needed for the final solve step in the last time step.
- How do iterations change over the course of the simulation?
- **Optional**: Get annotated solvers for more verbose output: <u>https://github.com/exasim-project/annotated\_solver</u>
- **Optional**: How does the number of iteration change with increasing mesh sizes: • Use 'refineMesh' and 'mapFields' to increase the number of cells

## Exercise 3:

- Change the tolerance of **pFinal** to 1e-04, 1e-05, 1e-07. How are number of iterations and timings affected? At which point are the simulations unstable?
- Use PBiCGStab as a solver for **p**, how are the number of iterations affected, how is the timing affected?
- Use GAMG as a solver for **p**, how are the number of iterations affected, how is the timing affected?