Daily Research Report

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1 Current Research Direction

The current research direction is to

1. The MMS was used to create a closed analytic form for the solution that I want for the "final" test problem. The issue is that one MMS cannot simultaneously test all conditions.

   The first solution tests an annular duct with liners and with arbitrary axial and swirling flow. This was done to exhaust each variable in the LEE. The manufactured solutions were generated using a summation of tangents for the mean flow profile and for the perturbation variables. Although each variable is set to a non zero value, this does not test the implementation of the L'Hopital's rule.

2. The second solution tests a cylindrical duct with hard walls with a uniform mean flow profile. The objective here is to use the MMS along with the actual analytical solution. This will set up the framework for a solution validation. The reason for doing this is because there are aspects of SWIRL that do not get tested by calculating a rate of convergence. The first component that needs to be tested is the radial mode zero crossing method.

   The main question that needs to be addressed is when and how should the modes that do not have a physical meaning be removed. The question of when is referring to which combination of grid points and numerical schemes give a sufficient answer? If a sufficient answer is decided when we have a certain order of accuracy, this does not necessarily mean we will have the correct modes.

   If we know that a certain scheme (2nd order or 4th order) needs a certain number of grid points per wavelength, then there is an inherent mode limit that comes from the numerical scheme of choice. This can determine the bounds of the "reduced mode problem"...

2 Research Performed

The L2 and Error was added to the output for all four LEE equations and speed of sound at each grid. The Error better shows a comparison between the actual and expected solutions.

3 Issues and Concerns

I'd like to start using second order or fourth order dissipation but by finishing my first attempt at a solution validation, I'll get a better idea of what I would need for dissipation if I need it at all for the scheme and grid I choose.

4 Planned Research

Make is going to be used to call the different modules for the two (or more MMS tests). I have been switching back and fourth and Make will just make it so

the files can be run as needed. The MMS results for the second solution will be reported. After a certain mode, the modes begin to get noisy and the hypothesis is because there is not enough resolution (in one of the numerical methods or derivatives) so the number of modes to look at at once will be decided. If we are only looking at 4 modes for example, then we need to have enough resolution for that test.