Daily Research Report

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1 Current Research Direction

The goal is to analyze the data from SWIRL so that I have all the data I need this week. I am doing a prelimary results section to see if I am documenting my results properly.

2 Research Performed

The MMS was used to determine the asymptotic rates of convergence for the numerical integration and for the LEE which contain radial derivative. The results show a series of grids starting with 7 grid points and doubling with each iteration. After seven iterations the numerical integration method was converged to second order accuracy. After nine iterations the LEE ROC was 1.956908751121.

A series of hyperbolic tangents were used to obtain a mean flow profile with significant slope changes at various locations along the radial grid. The same method was used to obtain the manufactured expressions for the perturbation variables Figure 2 shows the expected vs actual speed of sound obtained from SWIRL. Figure 3 shows the gradual decrease in error for the first 3 grids used for the speed of sound. The same first three grids were used as demonstration for the LEE.

The source terms show what is keeping the code from converging. Note that the locations where there is a steep gradient, there is a lot of change from grid to grid at low grid points. The reason for this is that Second order differencing needs a high number of grid points to resolve numerical approximations around large derivative values. Note that S_4 converges relatively quickly but also lacks the large gradient changes.

3 Issues and Concerns

I should super impose the fourth order results for the final number of grid points chosen.

4 Planned Research

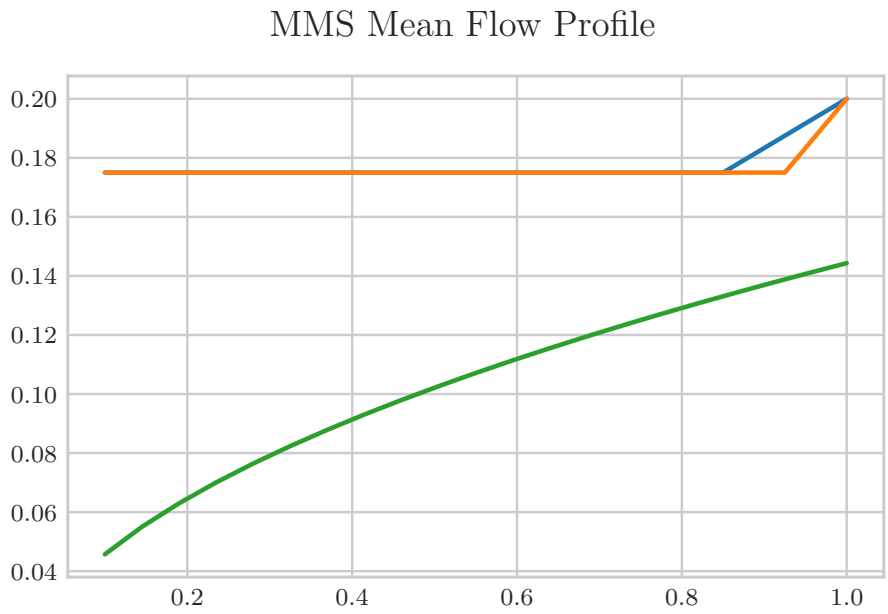

Figure 1: Mean Flow Profile for the Manufactured Solution Test

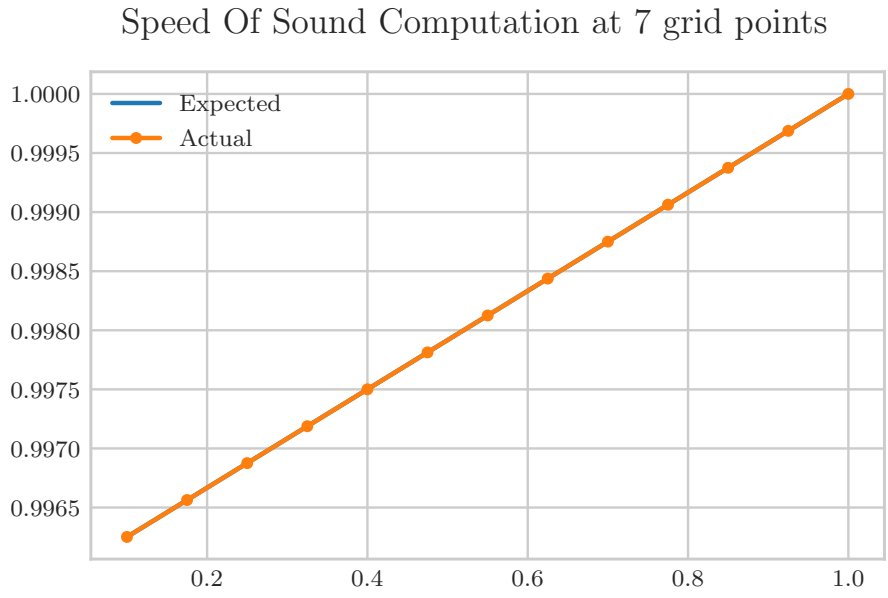

Figure 2: Expected vs Actual Speed of Sound

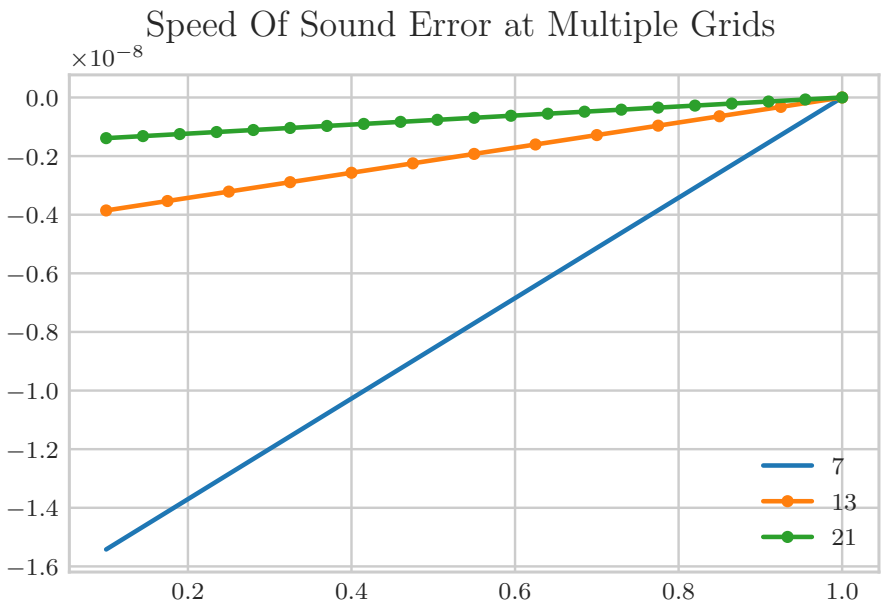

Figure 3: Speed of Sound Error

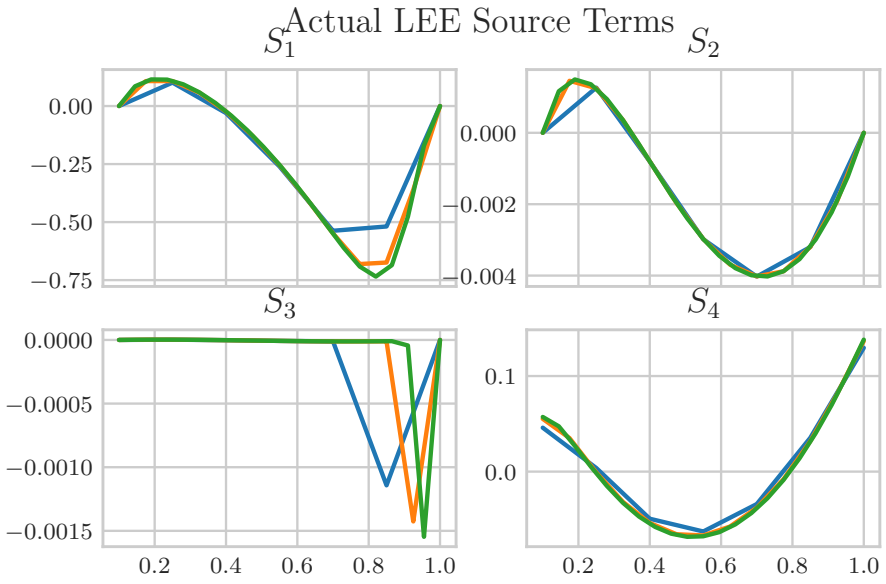

Figure 4: Actual LEE Source terms for the first 3 grids

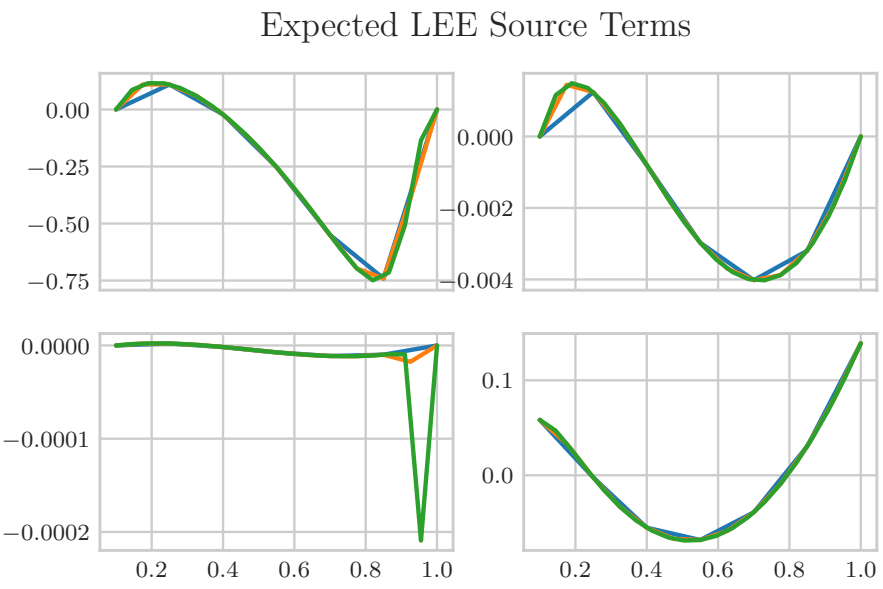

Figure 5: Expected LEE Source terms for the first 3 grids

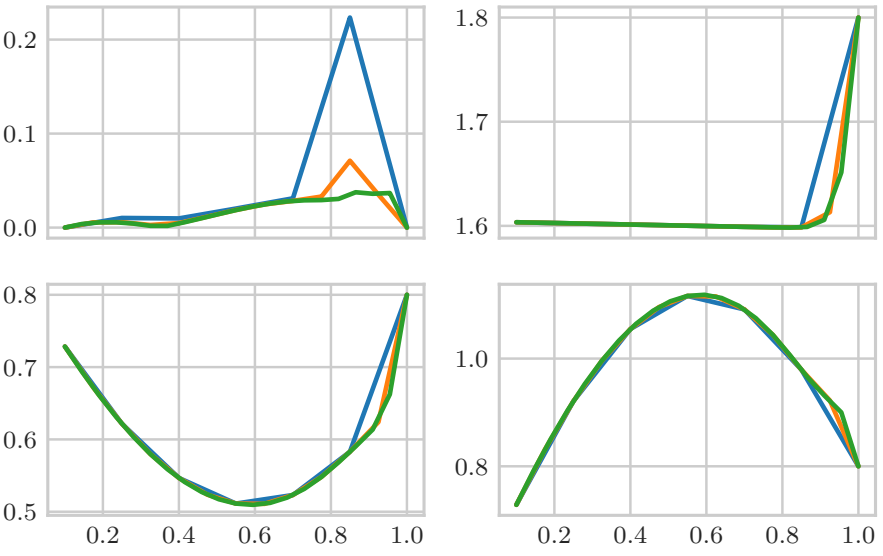

Figure 6: Source Term Error

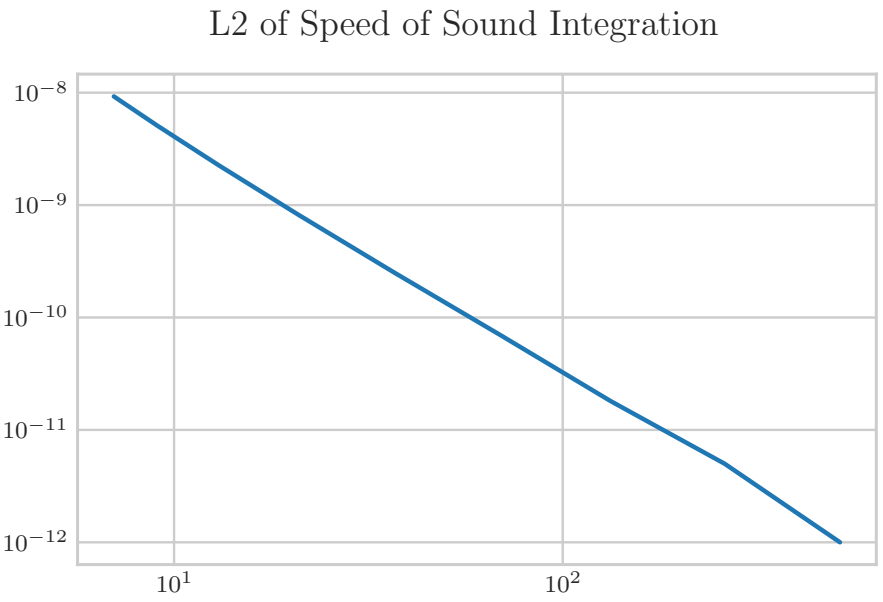

Figure 7: Speed of Sound L2

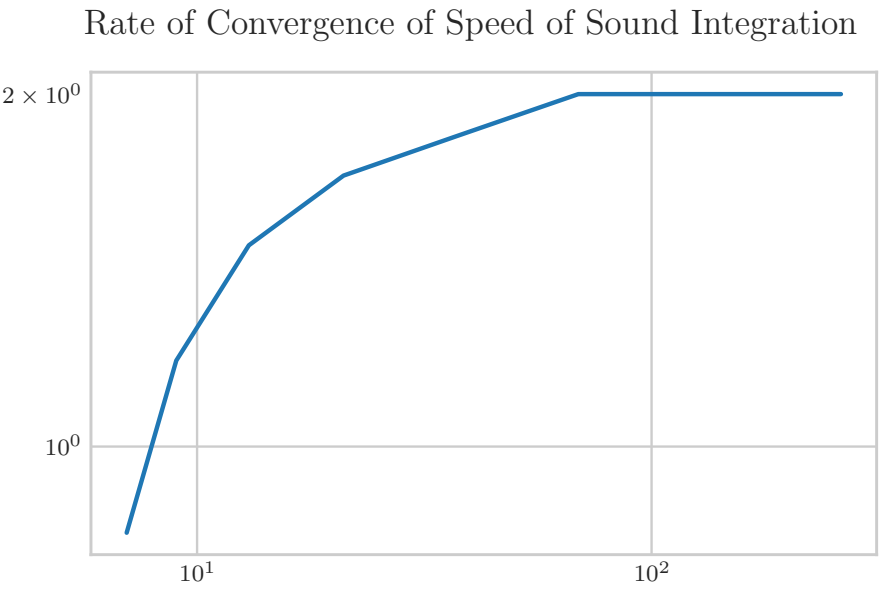

Figure 8: Speed of Sound ROC

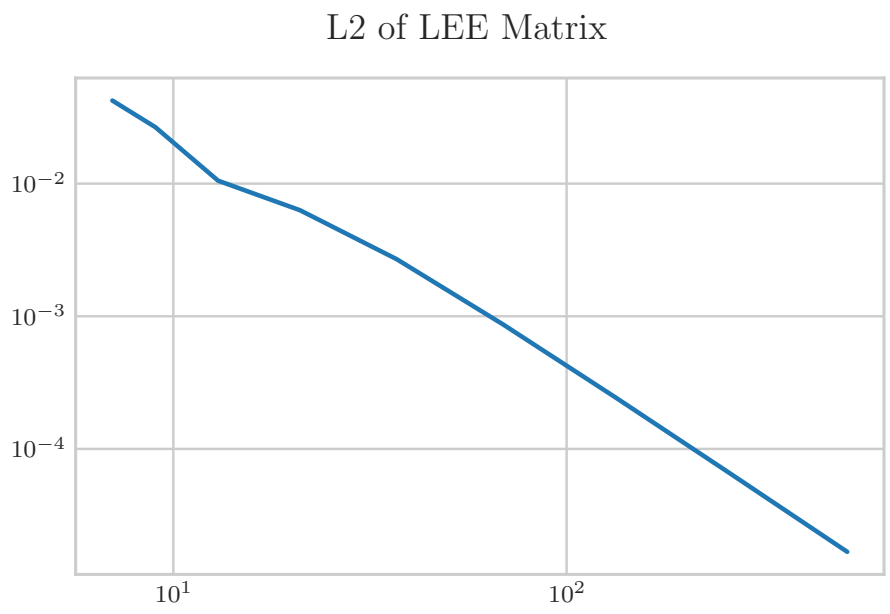

Figure 9: LEE L2

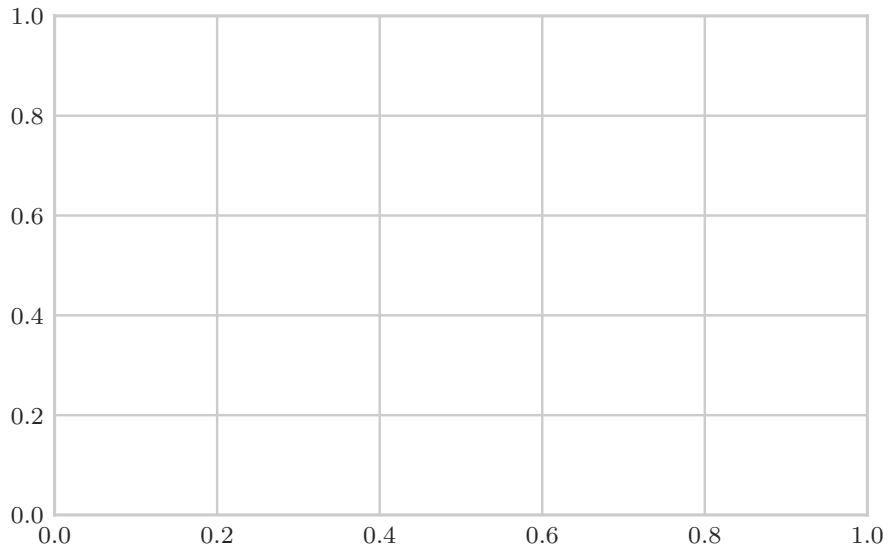

Figure 10: LEE ROC