Dispersion-Relation-Preserving Finite Difference Schemes for Computational Acoustics

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Journal of Computational Physics (1993), vol. 107, pp. 262-281

A list of question regarding DRP schemes, by Michael Crawley

# Optimized Spatial Discretization

Calculating the dispersion-relation-preserving coefficients for a first order derivative for a given accuracy order (as long as the accuracy order is greater than 4th) is relatively straight forward. However, it is not clear to me how one would calculate the coefficients for higher order derivatives. For a higher order derivative, the discretization results in the following equation:

where is the derivative order. For a first order derivative, this equation can be plugged into the defined integration error function, and the coefficients can be solved. However, for higher order derivatives, this results in a nonlinear integrated error function which cannot be solve using basic linear algebra techniques as was used in the first order case.

# Optimized Temporal Discretization

As with the algorithm for calculating dispersion-relation-preserving coefficients for optimized spatial discretization, the algorithm presented for calculating optimized temporal discretization coefficients appears to only be linear for first order derivatives. Either I am misunderstanding the algorithm, or a more general definition for the integration error needs to be developed.

# Numerical Damping

In many CFD/CAA simulations, the researchers use what they refer to as “sponge regions” along the boundary of the domain, in order to prevent acoustic reflections at the boundaries. Are these sponge regions at all related to the numerical damping discussed in this section?