Important characteristics of the aeroacoustic wave propagation are mostly encoded in their dispersion relations. Hence, a computational aeroacoustic (CAA) algorithm, which reasonably preserves these relations, was investigated. It was derived using an optimization procedure to ensure, that the numerical schemes, however, are not adequate for solving the aeroacoustics problems; these problems are time dependent, their amplitudes are often several orders of magnitude smaller, and yet the frequencies are several orders of magnitude larger than the flow field variations generated by the sound. Hence among the requirements that should be placed on a CAA algorithm are the minimal dispersion and dissipation features. This often conflicts with the requirement of "mainstream" CFD, which is to reach steady states, i.e., either damped out or removed from the domain the transient disturbances created during the start-up of the computation. High-fidelity is paramount for the resolution of acoustic problems; but, a consistent, stable, and convergent high order scheme is not necessarily dispersion-relation preserving and thus does not necessarily guarantee a good quality numerical wave solution for an acoustic problem. Demonstrated in the present paper is a validation of a dispersion-relation-preserving (DRP) scheme, first introduced by Tam and Webb,\(^2\) and a compatible set of radiation and outflow boundary conditions.

In the recent past, most commonly used computational methods have been of the acoustic analogy type. With such a method, the aeroacoustic problem is reduced to a nonhomogeneous wave equation for the noise, with its right side equal to a distribution of acoustic sources of strength related directly to the characteristics of the flow. A good example of acoustic analogy application to helicopter aeroacoustics was given by Hawking.\(^4\) Another commonly used method is the Kirchhoff approach, where the solution is obtained by integrating the wave equation external to some real or imaginary surface on which the relevant acoustic data is known. Among the applications of this method is by Hawkins,\(^4\) who used a stationary-surface Kirchhoff formula to predict the noise from high-speed propellers and helicopter rotors.

Linear perturbation potential methods have also been applied for the aeroacoustic problems. Since a quiescent or a uniform flow is generally assumed, the potential methods are similar to the acoustic analogy equations except that the dependent variable in the wave/convective-wave operator is the perturbation velocity potential. Atassi et al.\(^5\) for example, used this method to study the far field acoustic radiation from a lifting airfoil in a three-dimensional gust. Perturbation Euler techniques have recently received attention from the acoustic community and also the unsteady-flow community at large. Hartharan and Bayliss\(^6\) computed the acoustic radiation in cylindrical ducts by using the linearized Euler equations in a quiescent field. Meadows et al.\(^7\) solved the nonlinear Euler equations to compute unsteady shock waves.

The direct simulations of acoustic wave propagation have also been tried by solving the Navier-Stokes equations. For example, Rider and Beddini\(^8\) integrated the axisymmetric Navier-Stokes equations for the acoustic radiation of sound from resonance tubes. Baysal et al.\(^9\) investigated two devices to suppress the high tones generated by a high-speed cavity flow as an integral part of CAA, three spectral analysis methods were included in the present study. These are the Blackman-Tukey,\(^11\) the periodogram,\(^12\) and the weighted-overlapped-segment-averaging (WOSA)\(^13\) methods. The former two of these methods were implemented using box-car and Hanning windows. The latter method was compared for different