Modeling of sound propagation through moving media using a “vector”parabolic approximation

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Two of the principal characteristics which influence acoustic propagation in a moving fluid are the sound speed (celerity) and velocity of the medium. Their variations can create focusing and defocusing of an acoustic wave. The forward propagation is typically described using a "scalar" parabolic approximation, in which variations in the media are represented as an effective celerity $C_{eff} = C + Vx$, where the x axis gives the direction of propagation of the acoustic wave. In this representation, the velocity field is considered as a scalar field. But it is only valid for small deviations from the axis of propagation.

Two new derivations of the parabolic equation which treat velocity disturbances as vectors have been recently developed: TW-WAPE (Turbulent Wind Wide Angle Parabolic Equation) and MW-WAPE (Mean Wind Wide Angle Parabolic Equation). These equations provide a much better approximation, especially for large deviations from the axis of propagation.

In this talk we present numerical simulations using these "vector" PEs. Two cases will be presented: the scattering of sound waves by vortices, and outdoor sound propagation.

Friday, November 22, 2002

11:00 a.m., 234 Ames Hall