December 1966 Brief 66-10700

NASA TECH BRIEF

Problem of Oscillating Cone in Supersonic Flow Is Solved by Small Perturbation Techniques

The calculations for the flow field about a circular cone in steady supersonic flow with or without angle of attack is well known. For the case of the unsteady flow about an oscillating cone, the situation is somewhat different. In general, the governing equations cannot be simplified to any great extent. If, however, the motion is assumed simple harmonic, the amplitude of the oscillation is assumed small, and the nonlinear terms are neglected, then the equations can be separated and a set of recurring linear differential equations is obtained. When these equations are solved numerically together with the appropriate boundary conditions, the solution of the flow field around an oscillating circular cone in supersonic flow is obtained.

A detailed discussion of this problem is contained in NASA contractor report, "Solution of the Supersonic Flow Field Around an Oscillating Circular Cone," by Pao-Tan Hsu, NASA CR-61064, Massachusetts Institute of Technology, December 1964.

The unsteady perturbations are expressed in series form in powers of the radial distance and the coefficients of each term are expressed as functions of the inclination angle. By means of linearization, a system of linear differential equations is obtained for each order of the power series. The solution for each set of equations is obtained by numerical integration, using the proper initial conditions given at the shock. For any arbitrary mode of oscillatory motion of the cone, the solution can be obtained by solving for the proper combination of the shock motions. The force and moment coefficients are calculated in terms of the coefficients of the power series.

Note:

Copies of the report are available from:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B66-10700

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Pao-Tan Hsu
of Massachusetts Institute of Technology
under contract to
Marshall Space Flight Center
(M-FS-869)

Category 02