FLOW PROPERTIES OF A SPHERICAL BLAST WAVE

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A numerical method has been developed to predict the flow properties within a spherical blast wave from a free-air explosion, given only a single overpressure-time history at a fixed radius and the preceding shock
trajectory. This algorithm is based on the method of characteristics of one-dimensional unsteady spherical flow. It is of second-order accuracy in the physical (time-distance) plane and equivalently accurate (first-order) in the state plane.

Given only a part of the shock trajectory, this method can determine a corresponding part of the flow field and thus all flow properties. However, if the, shock-trajectory data are supplemented ' with a single overpressure-time history, then the extent of the calculated flow field can be greatly increased. Within this region, time histories at any radius can be easily obtained for overpressure, temperature and flow velocity, as well as for the dependent properties of density, sound speed, entropy, viscosity, flow Mach number and Reynolds number per unit length. Such information is a prerequisite for determining the drag coefficient, resulting drag loading per unit area and finally the dynamic response of an object or structure to the blast wave.

The program has been tested on an IBM-1130 computer utilizing auxiliary disk storage and excellent results have been obtained. It reproduced almost exactly the flow fields for the hypothetical point-source explosion without and with counterpressure as predicted analytically by von Neumann and numerically by Brode, respectively. When shock trajectory and overpressure-time data from a large field trial (Dice Throw, Mixed Company) are used in the program, then the predicted results are as accurate as the input data. In order to illustrate the inadequacies of past flow prediction methods, which typically use the overpressure- time history and simplified flow assumptions, results of the present numerical method have also been compared to those of previous analyses.