

PISCES 3DE -- A Computer Code for Analysing Dynamic Fluid Structure Interactions in Three Dimensions

M.S. Cowler, H. Hancock, M. Trigg

*Physics International Co.,
2700 Merced Street, San Leandro, California 94577, U.S.A.*

SUMMARY

This paper describes the theory and capabilities of the PISCES 3DE computer code.

PISCES 3DE is a three-dimensional Eulerian finite difference program developed by Physics International Co. for the dynamic analysis of asymmetric fluid-structure interaction problems. The code is the first step in extending the current two-dimensional capabilities existing in the PISCES 2DELK computer code [1,2,4] to three dimensions.

Since three-dimensional problems often require large grids, particular attention has been paid to efficiency of computations and data management in PISCES 3DE. The code has been designed to take maximum advantage of machines with vector processors. Use of available storage has been optimized so that large problems can be performed efficiently on a broad spectrum of machines.

The three-dimensional Eulerian finite difference scheme uses explicit time integration to solve the conservation equations of mass, momentum and energy for compressible solids and fluids. The equations are solved within a grid of arbitrarily shaped hexahedral cells.

Shocks are computed using the artificial viscosity technique; while material interfaces are followed through the Euler grid by a material fraction scheme based on the SLIC algorithm developed by Noh and Woodward [3]. The scheme allows any cell to contain multiple materials in pressure equilibrium.

Standard material models include a JWL equation of state for high explosives and a two-phase thermal equilibrium model for water. Material nonlinearities are treated by plasticity models based on von Mises or Mohr-Coulomb yield conditions.

Internal and external wall boundaries and time-dependent flow boundaries can be easily modelled. Flow boundaries are often used to model valve opening or pipe break conditions.

An application of PISCES 3DE to a reactor safety problem is described in a complementary paper in which the decompression following a pipe break in a Pressurized Water Reactor (PWR) is analysed.