DYNAMIC DRAG OF A SPHERE SUBJECTED TO A SHOCK WAVE: VALIDATION OF FOUR HYDRO-CODES

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This paper is concerned with the numerical evaluation of the dynamic drag of a rigid 80 mm sphere subjected to a step shock wave with a Mach number of 1.22. The main purpose of the paper is validation of various hydro-codes: the GRP hydro-code based on the "Generalized Riemann Problem" solver of Ben-Artzi and Falcovitz, the MSC/Dytran commercial hydro-code based on the Roe solver, the ANSYS/Autodyn commercial hydro-code and the Ls-Dyna commercial hydro-code with an Eulerian penalty algorithm.

The results of the four hydro-codes were compared with the measured results of Tanno, obtained by careful accelerometry of the sphere suspended in a vertical shock tube.

Fig. 1 gives the time history of the calculated drag coefficient, together with the measurement of Tanno. The results of the GRP and Dytran codes are very close and in good agreement with the measurement. Note the negative drag at late times which is a result of the shock wave converging toward the axis of symmetry behind the sphere, with a correspondingly high back pressure. We propose that this negative drag phase serve as a critical test for hydro-codes validation.

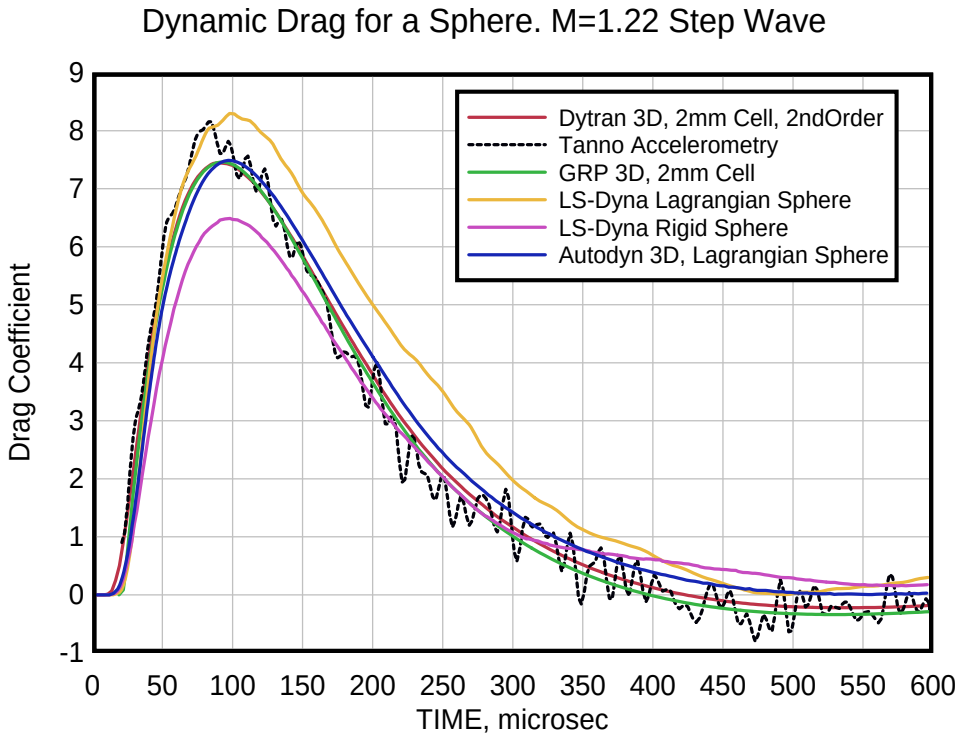

Fig. 1: Time histories of the drag coefficient for the four hydro-codes.