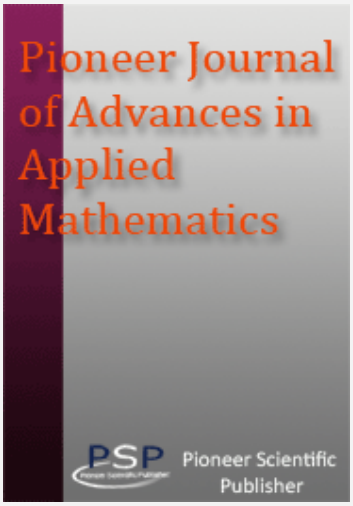
Pioneer Journal of Advances in Applied Mathematics
Volume 13, Issues 1-2, Pages 31-69 (February & April 2015)

ISSN: 2231-1858



HYDRODYNAMICS OF ORTHOTROPIC SHAPES UTILIZING ELLIPSOIDAL HARMONICS

I. K. Chatjigeorgiou, G. Dassios and T. Miloh

Abstract

Hydrodynamics (inviscid fluid and irrotational flow) of rigid bodies with three mutually perpendicular plans of symmetry (orthotropic shapes) moving in confined media (wall, channel etc.) is analyzed by applying Lamé's functions and ellipsoidal harmonics. Towards this goal, a general numerical scheme for computing ellipsoidal harmonics of arbitrary order and degree is presented. In order to demonstrate the versatility of the method, which maybe is useful in many practical applications in mathematical physics, we chose to analytically address here the case of a tri-axial rigid ellipsoidal vessel moving steadily near a rigid wall or along the center of a two-dimensional channel. Free-surface effects are ignored and we are mainly interested in determining the dependence of the hydrodynamic added-mass coefficient and the asymmetric pressure (suction) force exerted on the body due to external flow disturbances such as nearby planar boundaries or flow producing mechanisms (singularities) simulating for example a propulsive system.

Keywords and phrases: ellipsoids, Lamé functions, ellipsoidal harmonics, hydrodynamics, attraction force, added mass.