A Study of the Effect of Cavitation Induced by Underwater Explosion

E-mail: 9806450@ mail.dyu.edu.tw

ABSTRACT

An underwater explosion near a free surface consists of an explosive gas-water-air system with a shock and a few free surface interactions as well as the presence of bulk and local cavitation regions. Bulk cavitation occurs near the free surface and can cover a relatively large area, while local cavitation occurs at the fluid-structure interface. The dynamic evolutions of bulk and local cavitations has significant influence on the nearby surfaces and thus have to be taken into consideration in the overall evaluation of the effect of an underwater explosion.

This thesis investigates the effect of bulk and local cavitations. The upper boundary and the lower boundary of a bulk cavitation zone are studied at first. And then the vertical kick-off velocities of ship structure in different drafts are estimated to study the local cavitation effects. Viable results provide the basis for further investigations into the use of fluid modeling in underwater explosion simulations.

Keywords : Underwater explosion   Shock wave   Cavitation   Free surface

Table of Contents

REFERENCES

[1] Driels, M.R., " The Effect of a Non-zero Cavitation Tension on the Damage Sustained by a Target Plate Subject to an Underwater Explosion ", Journal of Sound and Vibration, 1980, Vol. 73, No. 4, pp. 533-545.

[2] Felippa, C.A., Deruntz, J.A., " Finite Element Analysis of Shock-Induced Hull Cavitation", Computer Methods in Applied Mechanics and Engineering, 1984, Vol. 44, pp. 297-337.

[3] Reid, Warren D., "The Response of Surface Ship to Underwater Explosion", Aeronautical and Maritime Research Laboratory, 1996, DSTO-GD-0109.

[4] M?KINEN, K., "Cavitation Models for Structures Excited by a Plane Shock Wave", Journal of Fluids and Structures, 1998, 12, pp.85-101.

[5] Wood, Steven L., "Cavitation Effects on a Ship-Like Box Structure Subjected to an Underwater Explosion", Master Thesis, Naval Postgraduate School, 1998, Monterey, California.

[6] Schneider, Nathan A., "Prediction of Surface Ship Response to Severe Underwater Shock Explosions Using a Virtual Underwater Shock Environment", Master Thesis, Naval Postgraduate School, 2003, Monterey, California.

[7] Didoszak, Jarema M., "Parametric Studies of DDG-81 Ship Shock Trial Simulations", Master Thesis, Naval Postgraduate School, 2004, Monterey, California.

[8] Sprague, Michael A., Geers, Thomas L., "A spectral-element / finite-element analysis of a ship-like structure subjected to an underwater explosion", Computer Methods in Applied Mechanics Engineering, 2006, 195, 2149-2167.

[9] Gong, S. W., Lam, K.Y., "On attenuation of floating structure response to underwater shock", International Journal of Impact Engineering, 2006, 32, 1857-1877.

[10] Xie, W. F., Liu, T. G., Khoo, B. C., "The simulation of cavitating flows induced by underwater shock and free surface interaction", Applied Numerical Mathematics, 2007, 57, 734-745.

[11] Cole, Robert H., "Underwater Explosions", Princeton University Press, 1948.