Naval Forces – Sept. 1999
ITI Developed New Time Domain Ship Motion Program for High Sea State Conditions (SPLAShMo)

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Computer modeling is an essential tool to study the ship-helicopter dynamic interface. Indal Technologies Inc. (ITI), as a leader in the design and manufacturing of naval helicopter handling systems, has developed a 12 degrees of freedom helicopter-ship dynamic interface computer program, ***Dynaface***. The program is used extensively to evaluate, for major navies, the interface parameters between helicopter and ship throughout all phases of on-deck operations. Since ship motion is the main source of destabilizing forces which act on embarked helicopters, ITI has developed a fully 3-dimensional, non-linear, time domain ship motion computer model, ***SPLAShMo,*** to further enhance its analytical capabilities.

The current available models are based on linear theory and can only be used for conditions up to Sea State 5. A significant limitation of the linear model is the decreasing validity of the results for seas in which the wavelengths of significant waves approach the length of the ship. A further limitation of the model is that motion history for the ship is produced through a simple linear summation of statistical data for individual ship motions. These limitations restrict the present analysis capabilities to sea states 5 for larger frigates and lesser seas states for smaller ships. In light of the continuing trend toward deployment of smaller displacement naval vessels, operating in higher sea states, the analytical capabilities of the linear model are becoming increasingly restricted. A nonlinear (time domain) model would predict the ship motion for high sea states up to 9.

On the other hand, with ITI's new model, no linear simplifications are made, which enables large amplitude ship motions to be modeled. As well, computations are performed in the time-domain, allowing time-dependent dynamic effects of the ship and the water to be included. The ship motion algorithm used by ITI is well developed, in that it is the third generation of computer implementation. It incorporates the results of extensive independent testing and development, in which smaller vessels in very heavy seas were successfully modeled and compared with experimental data. Consequently, the capabilities of this new model actually improve when smaller ships in higher seas are analyzed – the opposite of the linear (RAO) model - and is exactly what is required for continued improvement in ship handling system design and analysis.

The non-linear time-domain model removes all sea state and ship size restrictions, by accounting for variations in the true waterline of the ship, including the effects of the ship on the passing waves, the viscous effects of the water on the hull, and the depth of the sea. As well, all currently modeled sea conditions and locations – including the North Atlantic, Mediterranean, Indian Ocean and others - will be incorporated into the modeling capabilities. And, because this true-to-life model will require significantly more computational effort than the present one, ITI has upgraded its computing capabilities. to make full use of the model's capabilities.

The need to produce a state-of-the-art ship motion computer model is fueled by the trend towards operating large shipborne helicopters on board small naval vessels, in high sea state conditions. This combination significantly increases the securing demands, in all sea states, and makes accurate analysis of the helicopter-ship interface increasingly important. The crux of the problem is that securing the helicopter is dependent on the entire combined motion of the ship (roll, pitch, yaw, heave, surge and sway), and not simply the extreme motions of a single component. The combined effects of the deck angular displacement and various accelerations, along with the dynamics of the helicopter, often result in sliding of the aircraft, if it is not positively secured. This effect is increased for smaller ships operating with larger helicopters and, thus, demands the use of the best available analytical tools to aid in the design of all interface systems.

The development of this important tool greatly improves ITI's capabilities in the analysis and design of all types of handling systems, and makes possible the computation of securing loads for helicopter lashings under severe sea conditions up to Sea State 9 or up to the design limits of the ship.

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