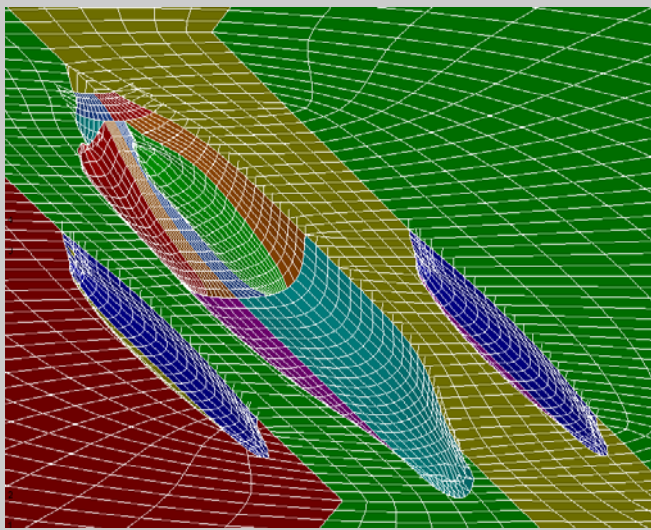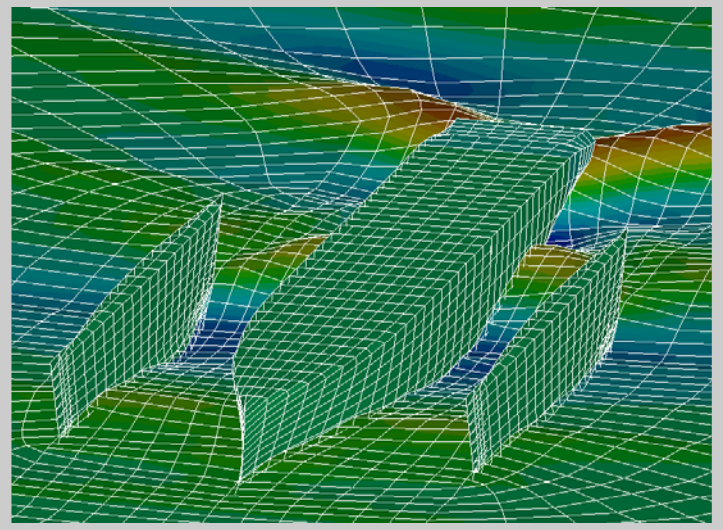# Motions and Structural Load Prediction Using Wasim

Wasim is a time-domain motion and load prediction program capable of analyzing practically any displacement vessel, including multi hull wave interaction and forward speed effects in its direct time step analysis. Since obtaining Wasim in January 2006, Viking Systems has used Wasim to predict motions and structural loads for Trimaran, FPSO, OSV, and Ocean Barge vessels in support of Viking Systems' structural designs.

Wasim Model of free surface and trimaran vessel

Wasim Predicted Wake Interaction between Hulls

Viking Systems has been using Nauticus and SESAM Software for the past five years for assessment of strength and fatigue of ships, FPSO vessels and offshore platforms. Within the past year, Viking Systems has also become a user of Wasim, and has implemented the software to study advanced hull forms and assess the impact of forward speed on motions and loads. Viking Systems has successfully used Wasim to calculate responses of trimaran hull forms, FPSO vessels, offshore supply vessels, and ocean going barges in support of their structural design activities.
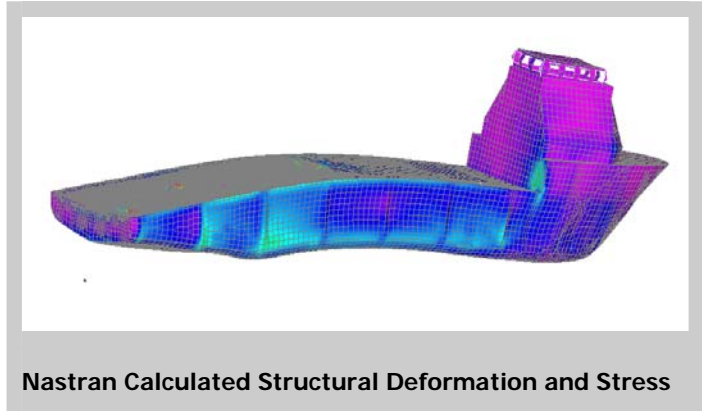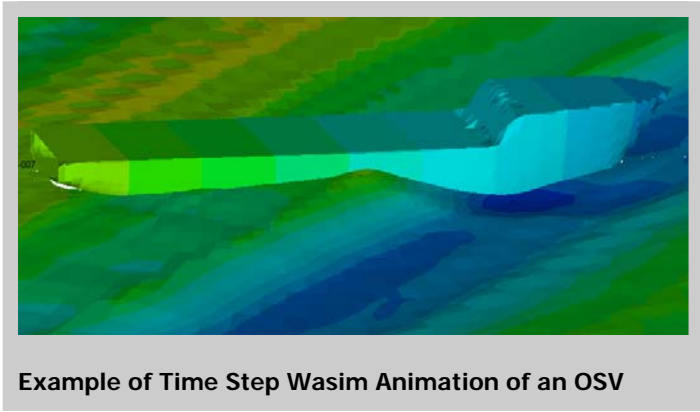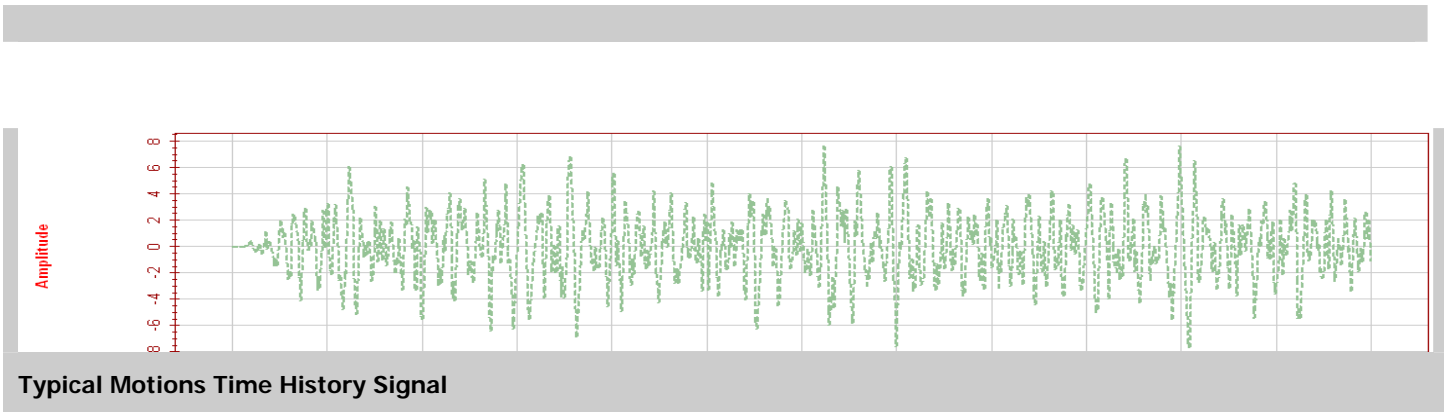
Wasim

The development and testing of Wasim started at MIT and has been further refined by DNV Software to fully function within SESAM. Wasim calculates the vessel responses while subjected to user defined sea states in the time domain. The Wasim program allows the user to simulate an input sea-state by defining a series of sinusoidal waves of varying amplitudes, lengths and initial phase angles, a process similar to physical model testing. Wasim solves the fully 3-dimensional radiation and diffraction hydrodynamic problem by a Rankine panel method, using panel models of both the hull and the free surface. Wasim uses the same hull form and environmental definition to solve either linear or non-linear analyses. The shorter solution time of the linear analysis is useful for initial analysis, or when designing a hull requiring hydrodynamic analyses of a large number of hull form variations or configurations. In addition, the results of the linear analysis can be transformed into frequency domain by Wasim's Fourier transformation option, allowing the data to be transformed into Response Amplitude Operator (RAO) format for additional processing, such as vessel length scaling of RAO data, and motions prediction in other sea-states. For vessels with highly varying hull form above the water line, the non-linear analysis includes the non-linear hydrostatics.

Trimaran Systematic Design

Viking Systems has used the Wasim software as the basis of an advanced optimization process to predict the most favorable hull form configuration of a trimaran vessel. The trimaran analysis was carried out by systematically varying the side hull spacing and longitudinal placement. Viking Systems used Wasim linear to evaluate twelve trimaran configurations at three different speeds. The resulting time series were Fourier decomposed into RAO's in the frequency domain. The processed data results in speed and hull form dependent RAO data that were used to further calculate responses for a number of sea states and vessel lengths using RAO scaling laws.

The motions results were then processed for each configuration against a defined set of sixteen criteria, allowing for selection of the most optimum design.

Wasim was also used to calculate relative displacements between the hull and the free surface. The relative displacements were used to determine the occurrence of

Typical Motions Time History Signal

Example of Time Step Wasim Animation of an OSV

Nastran Calculated Structural Deformation and Stress

vessel slamming, green seas or propeller emergence. In addition, Wasim was used to predict and evaluate the complex wave interactions between the hulls of the vessel, including the effect of the side hull stern wave on the emergence of the center hull propellers.

Successful Software Design
Viking Systems used prior knowledge and experience with SESAM to implement several data processing features into their SAGA structural design program. The SAGA features include:

- Hull Form Translator to create Wasim input files from AutoCad or typical hydrostatics programs
- Mass Model Translator from FEA programs to SESAM format
- Sea-State Generator to create series of sinusoidal waves to define specific design environment
- Result Processor for combination of RAOs with multiple sea states and length scales.

The software development allows the model and wave loads for a large number of hydrodynamic analysis runs to be reliably set up, and ensures a consistent assessment of vessel responses against criteria. The environmental loads developed by Wasim can be transferred to structural FEA models for assessment of ultimate loads and fatigue loads using SESAM. To remain flexible and competitive, Viking Systems has further implemented the capability to use Wasim loads using the company's Nastran based structural programs.

Wasim Non-Linear Capability
The non-linear version is capable of analyzing the non-linear hydrostatics of the free surface acting on the hull form by updating the free surface profile for each time step. The non-linear Wasim is therefore far more time consuming during the calculations and is therefore used only when:

- A vessel hull form is highly non-linear
- A particular vessel is ready for detailed design
- A design has been narrowed down to a limited number of choices

Wasim Software Support
Viking Systems has been a user of DNV Software programs for the past five years, and has continued to add SESAM programs to expand their capabilities. The company asserts that a primary reason for selecting DNV Software programs, is the outstanding customer support and service that is behind every program. "The customer service and support personnel have continued to impress us with their timely and accurate service", says Lars Henriksen of Viking Systems.

Viking Systems
Structural naval architectural company, offices in Annapolis and Houston with engineering staff of ten. Main areas of expertise include structural design, verification, and classification of:

- FPSO and Tanker Vessels
- Container Ships
- Offshore Supply Vessels
- ATB Vessels
- Cruise Ships
- Naval Vessels
- Offshore Platforms

Website: www.viking-systems.net