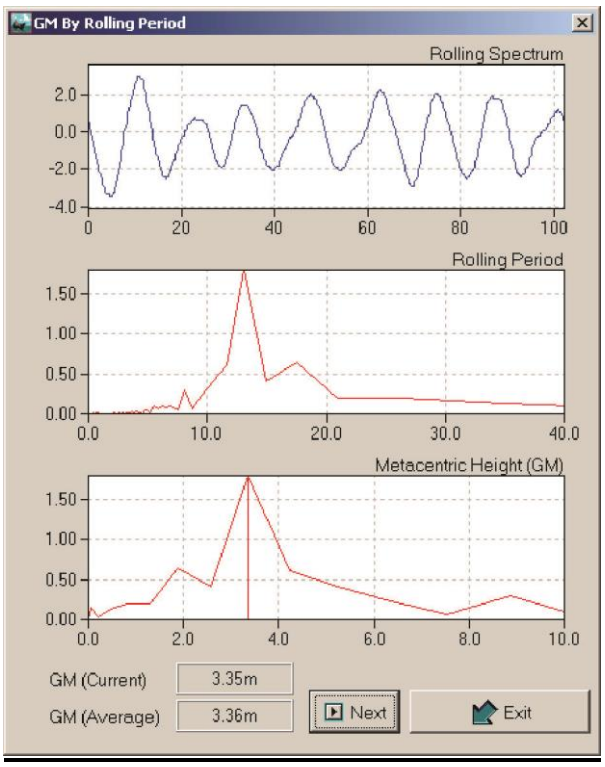

Avoid stability loss or parametric rolling : Online Stability Monitoring

Introduction

The new version of IMACS, Totem Plus automation system, contains some interesting new features. This article will focus on Transverse Stability parameters (GM, VCG) and their determination, either before departure or during the voyage. The analysis to determine stability is done automatically, without any assumptions by the user, as a tool for increasing safety of ships during sea voyages. This feature is important on any vessel, but especially on car carriers, container ships and similar vessels where the amount of cargo is based on shore declaration and not on measured values.

The risk of wrong assumptions

Wrong cargo figures are not as common as they used to be when the container trade started, but nevertheless they pose a great risk. A real such case happened some years ago when a container ship sailed west from a US port, with more than 200 empty containers in the manifest. In fact those were not empty but loaded containers waiting to be shipped eastbound on another vessel. While this illustrative case is possibly an extreme scenario, wrong information can come from

many sources: shippers declaring false weights, terminals (loading different containers than planned), planners, stevedore companies, tally companies etc. Naturally such discrepancies affect the stability of the vessel, which assumes a different distribution of cargo than the one actually onboard. Captains and Chief Officers can tell many stories about similar cases, where the actual situation of the vessel did not match the results of the stability calculations or the loading computer. In addition, stability parameters can be altered by other scenarios, not necessarily fully known to the operator, such as flooding of cargo holds and so forth. Needless to say, the huge risk to seafarers from a situation where the stability parameters are wrong cannot be over emphasized, and requires determination methods that will not depend on any assumptions.

Stability determination prior to sailing

A prudent captain will not go to sea without checking his stability. Accurate calculations of stability parameters, mostly done with the aid of a loading computer, are a mandatory procedure. But these calculations are based on various assumptions that can lead to erroneous results. To determine if the results of the stability calculations are correct, and to verify that the stability of the vessel is not jeopardized by a different weight distribution, Totem Plus IMACS offers the solution: the operator can perform a quick "inclining experiment", which will be carried out automatically as described below and as shown in Fig. 1.

Inclining Experiment

The inclining experiment method for determining the Metacentric Height (GM) is used while the ship is docked, after the cargo operations are completed and just before sailing. The principle behind this method is that the shift of a known weight across the ship (by using the ship's ballast system) causes a heel angle that is directly related to the GM. The result depends on the displacement of the vessel, which can be determined exactly from the measured draft. The shifting of the test weight and the measurement of the resulting heel angle are done automatically on request. As can be seen in fig. 1, the operator can decide between few options, like the number of ballast tanks and pumps used to transfer the test weight, and the method to determine the displacement from the draft (see picture). After the test is performed the calculated VKG and GM are displayed.

This method is especially useful and effective when performed right after the ship is loaded, in order to determine the actual GM on departure, which might be different from the theoretically calculated GM due to erroneous weight distribution as explained above.

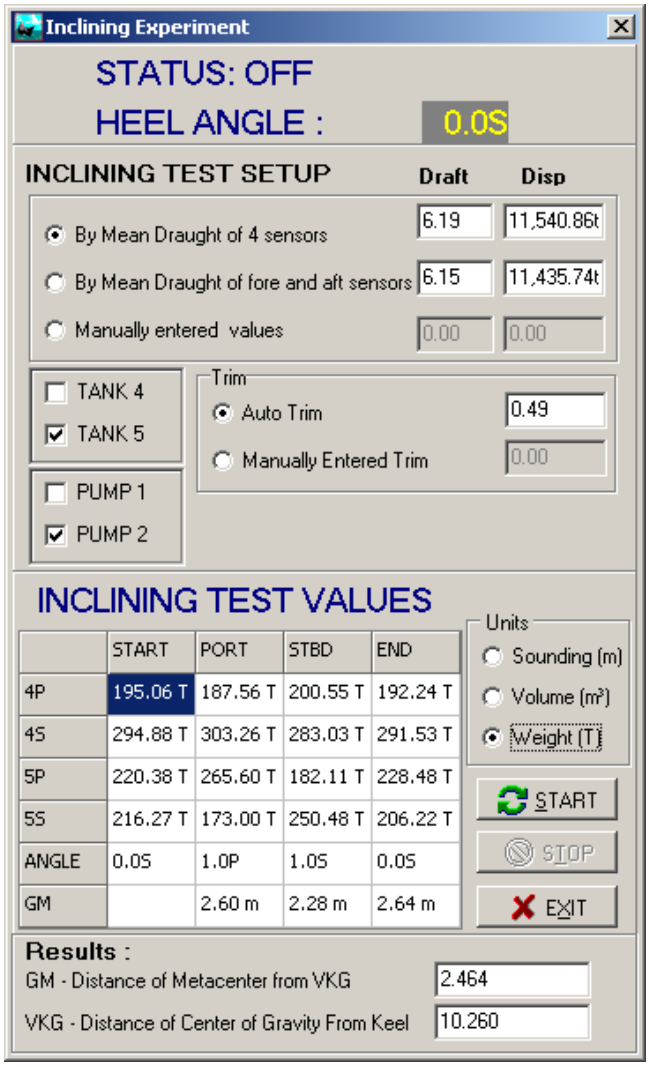

Figure 1: Inclining Experiment

Stability determination while sailing: rolling period.

The risk to ships from losing stability during a voyage at sea can emanate from many factors, including unknown flooding of compartments and human errors. Knowing the stability parameters (GM) at all times is therefore of utmost importance. Furthermore, such information can help in avoiding parametric rolling in rough weather.

Totem Plus method for calculating GM while the vessel is at sea requires no user intervention or assumptions. The ship's rolling angle (caused by wave and wind forces acting on the ship's hull) is constantly monitored. Advanced mathematical algorithms are applied to the data to deduct the rolling period and the metacentric height (GM). This process is performed continuously, in real-time, and provides a visual representation of changes in GM over time. An example of such analysis is shown in Fig. 2.

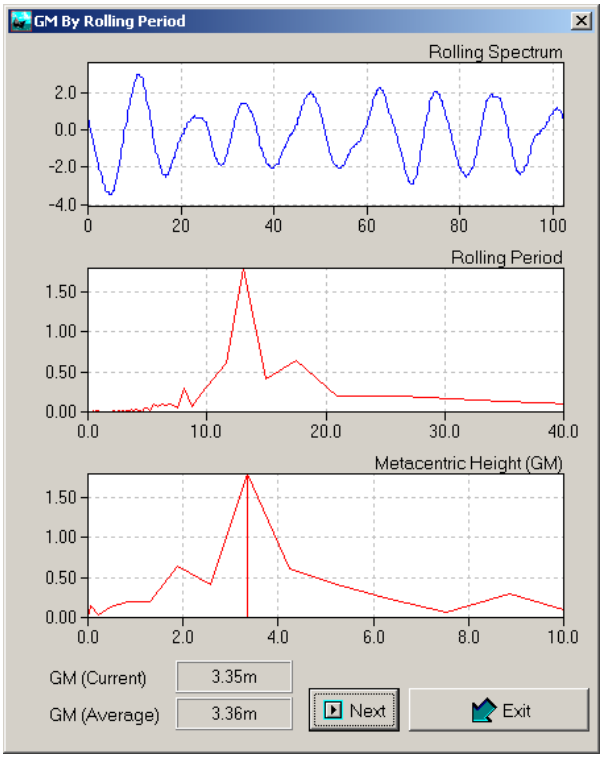

Figure 2: GM by Rolling Period

Alarm will be issued whenever the GM is less than the allowed minimum for that type of vessel, and whenever the GM shows a significant trend of change in a specified duration (typically 60 minutes).

Example Case – M/V Cougar Ace

The M/V Cougar Ace is a Singapore-flagged RO-RO (Roll On-Roll Off) car carrier vessel. On July 23, 2006, she was en route from Japan to Vancouver, British Columbia, Tacoma, Washington, and Port Hueneme, California, with a cargo of 4,812 vehicles.

Figure 3: M/V Cougar Ace

During a transfer of ballast water, she lost stability and developed an 80-degree list to port. There were reports of a large wave striking the vessel during the ballast transfer, but it is unknown what effect this had on her loss of stability. The Cougar Ace was thrown sideways when the massive ship's ballast tank was adjusted in the open seas of the North Pacific.

"There clearly was imbalance in the intake of ballast water. The company investigation ultimately will tell us what caused that imbalance," a spokesman for Tokyo-based Mitsui O.S.K. Lines was quoted in the press after the incident.

Online Stability monitoring

Totem Plus' ***IMACS*** is an Integrated Monitoring, Alarm and Control System, and the Online Stability Monitoring was included in its features for the first time in 2006. Following the success of this feature it will be included also in Totem Ecdis, a new electronic chart system that is about to be releases in April 2008.