Written discussion of paper with title:

"*Numerical* procedure for evaluation of capsizing probability with split time method"

by V. Belenky & K. Weems,

to be presented at the ONR 2008 Conference in Seoul.

I had the privilege to discuss this work previously with the authors and I am very pleased that it has now reached the ONR Conference so that it can be debated more openly. One feels that a scientifically sound approach for the probabilistic assessment of ship stability is being developed, characterised by the testing of the limitations of hypotheses and by the evaluation of the deserved confidence on the figures produced by the numerical calculations. The philosophy of the method is in line with other efforts at international level addressing the same problem and it may be predicted that gradually, convergence will be achieved on a generally acceptable methodology.

At a more technical level, the authors may wish to take into account the following comments:

The separation of the problem into a "non-rare"part that takes place in a long time scale and can be treated by the theory of upcrossings; and a "rare" one that takes place in a short time interval and could be considered as essentially free of the wave effect, is practical and thus interesting. Perhaps more justification could be provided about the choice of the angle where the restoring curve is maximised as the upcrossing level. This angle would be the "natural" choice if one was dealing with an oscillator having a piece-wise linear restoring curve; but for a more realistic situation some further corroboration is probably necessary. One could even think that, by setting this threshold too high, the non-rare problem may in fact become a rare one. Because after all, how many times in a ship life span the angle of max GZ is exceeded?

It would be helpful if the authors discussed more specifically their perception of a rare event in terms of probability. It is realised of course that, by setting the upcrossing level below the angle of max restoring, several problems might arise: the assumption of Poison flow may "suffer" as frequent upcrossings could be occurring and the memory of the last upcrossing may be influencing the one that follows. Difficulties could be envisaged also for the "rare" part since the wave effect might not, in that case, be disregarded. But, to become more challenging, is the "rare" part's contribution to the overall probability of capsizing significant? Judging from Fig. 20 of the paper, and as one would expect, this part may not modify the order of magnitude of the overall probability. Moreover, in a practical context it would be reasonable to set as threshold of capsizing an angle that is less than the vanishing angle, such as the angle where non-watertight openings are submerged. This would reduce even more the contribution of the "rare" part.

The possibility of using the normal distribution for roll rates despite the nonlinear GZ, appears indeed as viable one, due to the weak nonlinearity of damping. Unfortunately such a simplification is not appropriate for the roll angle and the authors have handled this eloquently by developing a hybrid method as well as a spline fit. One wonders what the connection could be between the distribution of roll angle and the shape of the GZ curve. Perhaps a parameterisation of GZ and a systematic study on this could produce useful

results. Progress on this point may be a crucial one for the use of the method in ship design where several wave environments would need to be taken into account. There, one would prefer to avoid having to produce histograms from roll statistics based on many and possibly lengthy simulations.

Lastly, the authors have pointed out some difficulties concerning the prediction of the mean time before capsizing, especially as the angle of vanishing stability is increased. Could they foresee any possible way to overcome this or at least “alleviate” it during their probability calculations?

The authors are congratulated for developing an interesting methodology that presents good potential to reach the stage of practical implementation without compromising its scientific basis.

K.J. Spyrou

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