September 5, 2006

Position as “Experienced Researcher” for Statistical properties of surface gravity waves in unimodal and bimodal directional seas from direct numerical simulations of the Euler equations available at DNV, Det Norske Veritas, Hövik, Norway

DNV offers a position for a PostDoc who got his/her degree in Naval or coastal engineering with an interest and training in weather and wave conditions statistics, in particular such that are of interest for marine safety and capsizing. The duration of the appointment is limited to twelve months, from January 1, 2007.

Background

Marine accidents may represent a great disaster from a social and an economical point of view; the memory of the 37000 tons oil tanker “Erika” was still alive, when the “Prestige” accident happened on November 13th, 2002. Although many cases can be related to human errors, accidents still occur due to the ferocity of the sea. The recent encounter of marine structures and extreme waves (e.g. Caledonia Star - 2001, Bremen – 2001, Norwegian Dawn – 2005) have highlighted that improvements are needed to reduce the risk of these types of accidents. In this respect, it would be of benefit to the marine community to validate wave and load models adopted for design by using present day technology for monitoring of the ocean surface and by comparing them with higher-order solutions as well as to develop warning criteria to avoid dangerous sea states. It is likely that the significance of severe sea state conditions for ship traffic and offshore installations will even grow in the future because of the expected increase of extreme weather events associated with the global warming.

Weather and sea state conditions

Within the framework of the E.U. project MaxWave (see MaxWave, 2003, contract EVK3-CT-2000-00026) ship accidents reported as being due to bad weather conditions were analyzed to look for recurrent, dangerous sea state conditions. As a result, this investigation revealed that sea states characterized by two wave systems with different direction of propagation, also known as crossing or bimodal seas, often occurred at the presumed time of the accidents (see Toffoli et al., 2006a).

Aside from the difficulties of keeping the ship under proper control, crossing sea conditions are suspected to enhance the probability of occurrence for extreme waves (see, for example, Lehner et al., 2005). According to recent theoretical studies (Onorato et al., 2006), crossing seas in deep water may lead to the instability of wave packages; this would, in principle, facilitate the formation of extreme waves. By using numerical simulations, Toffoli et al. (2006b) analyzed the statistical properties of bimodal seas in deep and intermediate water depths by using second-order wave theory. The investigation of simulated time series showed that there are angles between crossing wave trains at which a significant deviation of the probability density function for the wave elevation takes place.

The research

One of the major shortcomings of second-order theory is that it can only account for small amplitude waves, i.e. small values of steepness; the latter represents the degree of nonlinearity in deep water. As extreme or rouge waves are expression of highly nonlinear sea states, i.e. high wave steepness, second-order wave theory underestimates the statistical distribution of the wave elevation at low probability levels. As a proper statistical description of surface gravity waves is important for design purposes, investigation of the statistical properties for extreme, bimodal sea states can be performed by
simulating random time series from the classical Euler equations (Whitham, 1974). Numerical simulations of these equations can be performed by using a higher-order spectral method (HOSM) (see, for example, Tanaka, 2001; Onorato et al., 2002, and reference therein). The analysis will cover both unimodal (i.e. sea states where only one wave system is present) and bimodal sea conditions; as a first stage, the research will only consider infinite water depths. Implications of higher order effects for the current design practice of marine structures shall also be documented.

The successful candidate should have a strong background in wave modeling and wave conditions statistics and good computer skills (Linux, Fortran).

**Background literature**


**Seamocs**

SEAMOCS (Applied stochastic models for ocean engineering, climate and safe transportation) is a Marie Curie Research Training Network (RTN) financed by the EU. The SEAMOCS initiative links meteorology and statistics with ocean and coastal engineering. The overall goal of research and training is increased marine safety and reduced capital and operational costs of sea transport and major off-shore installations. The consortium consists of three university research groups in ocean and coastal engineering, three university research departments in applied probability and statistics, and three public and private organizations engaged in activities to increase the safety of marine operations. The chosen candidate will have the opportunity to take part in courses and training programs offered by SEAMOCS partners, and to take advantage of other SEAMOCS activities related to meteorology, statistics and marine safety. Resources are available within the SEAMOCS project for this exchange.

**Formal requirements**

One of the aims of the Marie Curie program is to promote mobility. To be eligible, the candidate must not have the nationality of the host country (here Norway), unless he/she has been living outside of the EU and the Associated Countries for at least four of the last five years, and must not have lived and/or worked in that country for more than 12 months during the last three years.

**Additional information**

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- If you are interested, please send your application letter, CV and 2 reference letters Dr Elzbieta Bitner-Gregersen, Det Norske Veritas DNV Research, PO Box 300, N-1322 Høvik, Norway. Last day of application November 15, 2006.
- For citizens of non-E.U. or non-associated states, some restrictions apply.
- For information about DNV, see http://www.dnv.com
- SEAMOCS website: http://www.maths.lth.se/seamocs/
- Marie Curie opportunities website: http://cordis.europa.eu.int/mc-opportunities/