# Abstract

This thesis concerns the nonlinear loading and dynamic response of a rectangular box in two dimenions. A fully-nonlinear potential flow model and a series of experimental procedures are employed to describe the nonlinearities governing the floating-body behaviour. Adopting this twin-track approach, nonlinear forcing components are found to make major contributions to both the excitation problem and the motion response. Two main sources of nonlinearity are established: a first associated with higher-order wave-structure interactions, and a second associated with viscous dissipation.

The main advance of the present work lies in the quantification of the relative influence of these two sources. The first source, prevalent in steep wave conditions, is particularly significant in the diffraction regime and leads to significant excitation force amplifications. In deep water, these nonlinearities are primarily driven by interactions between the incident and the reflected wave components. The second source, due to viscosity, plays a minor role in the excitation problem, but has a major influence on the motion response. Viscous effects are critically important when the structure exhibits large motions, particularly at resonance.

The relative importance of both types of nonlinearity is discussed in regular waves, focused wave groups and random seas. The first two cases are included to gain a clear physical description of the problem, whilst the random sea states are chosen to relate to practical ocean conditions. Experimental data is provided for sea states comprising in excess of 150,000 individual waves, presenting one of the most substantial data sets of this kind to date. In considering this random sea data, the two sources of nonlinearity are found to approximately balance in heave, with a load amplification due to wave-structure interactions and a motion reduction due to viscous dissipation. In roll, viscous dissipation dominates the overall response.

Setting the work into its wider context, practical engineering approaches are also offered. A time-domain simulation, building upon a linear hydrodynamic description and a quadratic Morison's type drag term, is generally found to lead to a good agreement with the experimental data. An approach of this type is computationally very efficient, and hence suitable to day-to-day engineering practice.