Wave Propagation, Surface-Roughness Parameterization and Wind Gustiness

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LONG-TERM GOALS

My research is directed toward understanding wave generation and wave motion in the ocean and in laboratory simulations thereof.

OBJECTIVES

See **LONG-TERM GOALS** above.

APPROACH

My primary approach is through mathematical models. Solutions ultimately are developed in both analytical and numerical form, but my goal is to obtain analytical results that inform phenomenological models for the prediction of physical events.

WORK COMPLETED

(Includes work completed in FY00 but published in FY01.)

[1] J. Miles, "A note on surface-wave scattering by a small plate", *Wave Motion* **32**, 153-156 (2000).

[2] P.G. Baines & J. Miles, "Topographic coupling of surface and internal tides" *Deep Sea Res*. I **47**, 2395-2403 (2000).

[3] J. Miles, "Stability of inviscid flow over a flexible boundary" *J. Fluid Mech*. **434**, 371-378 (May, 2001).

[4] G. Ierley & J. Miles, "On Townsend's model of the turbulent-wind-wave problem" *J. Fluid Mech*. **435**, 175-189 (May, 2001).

[5] J. Miles, "Gravity waves on shear flows" *J. Fluid Mech*. **443**, 293-299 (September, 2001).

[6] J. Miles, "A note on surface waves generated by shear-flow instability" *J. Fluid Mech*. (in press, May, 2001)

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14. ABSTRACT
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15. SUBJECT TERMS

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[7] J. Miles, "Gravity waves in a circular well" *J. Fluid Mech.* (sub judice, July, 2001).

[8] J. Miles, "On resonant reflection by a plane grating" *Wave Motion* (sub judice, July, 2001).

[9] J. Miles, "On slow oscillations in coupled wells" *J. Fluid Mech.* (sub judice, August, 2001).

RESULTS

[1] determines the scattering of gravity waves by a fixed plate (deck of zero draft).

[2] concerns the generation of internal tides through the interaction of surface tides with oceanic bottom topography taking into account the horizontal components of the Earth's rotation (as in my 1975 paper on Laplace's tidal equations), which have been neglected in most tidal calculations.

[3] concerns the stability of an inviscid shear flow over an elastic plate (such as a ship's hull). The predicted threshold of absolute instability, as calculated through a boundary-layer approximation, differs from that calculated by Lingwood & Peake (1999) through numerical integration.

[4] revisits Townsend's (1980) model of wind-to-wave energy transfer, which is based on a putative interpolation between an inner, viscoelastic approximation and an outer, rapid-distortion approximation and predicts an energy transfer that is substantially larger than that predicted by my quasi-laminar model. It is shown that Townsend's (1980) predictions, although close to observation, rest on flawed analysis and numerical error. However, his (1972) model, after some corrections, yields results that are close to Mastenbroek's (1996) calculations.

[5] extends the earlier work of Burns (1953) and Yih (1972) on the eigenvalue problem for gravity waves on a shear flow of finite depth and non-inflected velocity profile. The critical wave number, for which the wave is stationary and to which the wave number must be inferior for the existence of an upstream-running wave, is determined.

[6] revisits Morland, Saffman & Yuen's study of the stability of a semi-infinite, concave shear flow bounded above by a capillary-gravity wave, for which they obtained numerical solutions of Rayleigh's equation. A variational formulation is used to construct an analytical description of the unstable modes.

[7] derives the resonant frequencies of the non-Helmholtz sloshing modes in a circular well that is bounded above by a free surface and below by a reservoir directly from the corresponding results for an aperture in a half-space (well of zero depth). The resonant frequency for the Helmholtz mode is determined separately. The results are applicable to "moon-pools" in oil-drilling ships (Molin 2001) and artesian wells.
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[8] determines the resonant minimum of the transmission coefficient of an infinite, periodic, plane grating for normal incidence of a plane wave.

[9] formulates the eigenvalue problem for slow oscillations of a liquid in a set of N wells that are bounded above by free surfaces and below by a common reservoir. Detailed solutions are obtained for

a pair of identical circular wells. The results are of practical interest in connection with marine operations and artesian wells.

IMPACT/APPLICATIONS

The results in [1] and [8] are applicable to coastal engineering and naval operational problems. The results in [4] and [6] contribute to our understanding of air-sea interaction. The results in [2] contribute to our understanding of the balance of tidal energy in the oceans. The results in [3] are applicable to a wide range of problems, including naval architecture, panel flutter and blood flow. The results in [7] and [9] are relevant to well bays in drilling ships.

TRANSITIONS

RELATED PROJECTS

PUBLICATIONS

See **WORK COMPLETED**.