Harnessing wave power in open seas

Raphael Stuhlmeier (Technion)

Abstract: Since the oil crisis of the 1970s, interest in extracting usable energy from water waves has occupied the minds of engineers, inventors, and policymakers. With the current focus on renewable energy, wave power is once again a topic of great current interest, as well as investment.

In this talk, (based on joint work with Michael Stiassnie, Usama Kadri, and Dali Xu) I will explore the possibilities of harvesting wave power in open seas, over large expanses of ocean basins. For reasons which are evident, current wave power designs focus on the nearshore; for equally clear reasons, in order for wave power to be a major player in world (or even regional) energy markets, large expanses of the open ocean must be utilized.

We address questions of multiple capture of wave energy by developing an exact, analytical model for an illustrative wave energy converter (WEC) in 1D and calculating its energy capture, as well as energy shadowing, under conditions of fetch limited wave-growth. The flexibility and tractability of this model, based on the relative motion of twin, vertically floating plates makes it amenable to other applications, e.g. in calculating coastal effects of WECs.

We also present some preliminary results for two dimensions, where energy capture by an idealized "farm" of floating twin-cylinder WECs under directional JONSWAP spectra is examined. Again, the focus is placed on developing wavenumber-dependent transfer functions that easily yield energy capture, transmission, and reflection, and allow for calculations of the potential for power harvesting in the deep, open ocean. Finally, some perspectives on future research and open problems will be given.