SOLID PARTICLE PROPAGATED BY A SURFACE GRAVITY WAVE

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ABSTRACT
Surface gravity waves have not been known to propagate solid material any great distance, and certainly not at the wave's phase speed. However, the suggestion is offered here that a wooden bead strung on a taut wire held at the mean free surface could travel with a wave crest as long as that crest remains a coherent feature. Preliminary observations in a swimming pool suggests that this idea will work.

Keywords: Surface Gravity Waves, Propagation of Solid Particles

1. INTRODUCTION

So far the greatest distance surface gravity waves have been tracked between a wind storm at sea and a continental shore is half way around the world [1]. No material traveled that far of course, mainly the wave shape and its energy.

Board surfers can move at the speed of a breaking wave; even faster if they make an angle to the direction of propagation. But that ride only lasts for about one wavelength.

Consider the following thought experiment, which begins with no prospect for a practical application. Stretch a thin copper wire across a calm swimming pool at the air/water boundary. Before making the wire taut, string a wooden bead on it which has a hole drilled large enough for easy translation along the wire. Then with a paddle send waves toward the bead. It should travel entirely across the pool. If one wave happens to dissolves, the one behind it will carry on pushing the bead forward. For good operation the dimensions of the

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bead must be significantly smaller than a wavelength. By this method a solid particle has propagated a significant distance with one or a few waves across open water.

2. EXPERIMENT

In a swimming pool a 25 ft copper wire was stretched all the way across the water and held taut at the still air/water boundary. On the wire was a wooden bead 1.5 cm long, 1 cm wide and had a hole 0.4 cm in diameter drilled through the center. Waves made by a paddle at one side of the pool were directed toward the bead.

The results of doing this several times were not completely satisfactory, mainly a good set of waves was difficult to produce. There was one burst forward of the bead noticed than was about ¼ the width of the pool but a complete crossing was never accomplished. Nevertheless it was clear to me and my helpers that the method was working and could become better if improvements to the set-up were carried out.

3. DISCUSSION

It is tempting to extrapolate upward in scale the above preliminary results to possibly entertain an application to ocean conditions. For example, if a long cable were fixed in place at mean sea level, could a fairly large piece of floating cargo be pushed along it some considerable distance by the naturally occurring swell? Feasibility of this idea may suffer from various practical complications, but those are not all known at this time.

A somewhat analogous experiment that worked was carried out years ago by Prof. John Isaacs at the Scripps Institution of Oceanography. He made a raft with vertically arranged doors underneath that were hinged in such a way that the raft would travel from the shore out to sea against the oncoming waves. Interested readers could probably track more details down on Google. Otherwise there are no references to cite for the presently proposed method.

It should be added for completeness that surface gravity waves do transport some fluid mass with a small velocity known as the Stokes drift, which is the equivalent of the linear momentum of these waves. Also orbital angular momentum of the fluid particles is propagated.

Reference

[1] Snodgrass, F. E., G. W. Groves, K. F. Hasselmann, G. R. Miller, W. H. Munk and W. H. Powers (1966) Propagation of ocean swell across the Pacific, Phil. Trans. Of the Royal Soc. Of London, A, **259**, 432-437.