Videos on constructive and destructive interference in wave dynamics and how waves breakup in shallow areas

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Short description

Wave physics is one of the most difficult sections of an undergraduate introductory physics course due primarily to the abstract nature of Huygens' construction, which is critically important for understanding the key concept of constructive and destructive interference. Briefly, the result of constructive interference is a higher wave front while that of destructive interference is a trough. The concept can be visualized in the above video taken at Labrador Park, Singapore. In addition to the concept of constructive and destructive interference, the video also features another facet of water waves: its interaction with land. Specifically, it can be clearly observed that as a complete wave front approaches shallow areas, specific segments interacting with the area would breakup into foamy water. This is the underlying mechanism leading to the formation of large waves common in tsunami, where a water column is forced upwards by shallow land. The four videos in this series should be useful for educators in junior colleges and those teaching introductory undergraduate physics courses as a science in action video, which hopefully makes learning the difficult concept of wave interference easier and more fun. In addition, wave interactions as a tide is coming onto shore is also a valuable source of videographic information for understanding the hydrodynamics at Labrador Park shore, especially in inferring how fast or slow beach is forming or eroding, which can draw upon on optical evidence of wave crest breaking up into foamy water near shallow areas.

Keywords: wave interference, wavelength, amplitude, trough, wave crest, Huygens' construction,

Subject areas: physics; geosciences;

Summary of videos

One plus one equals two. That is true in understanding how one wave crest interact with another wave crest of the same phase, which in common terms is in sync. When out of sync, such as one wave crest meeting another wave trough, one plus negative one equal zero. This is the essence of constructive and destructive interference in wave dynamics. Understandable when presented as in above, what is difficult is in understanding how two or more wave propagations interact at specific points of space in their interference zone. The tool to do this is Huygens' construction, but although

graphical in nature, it is a major bugbear of most students in understanding wave dynamics. Because students could not visualize the cross interaction lines on their Huygens' construction, and determine which nodes are constructive interference and where are the destructive ones. The intellectual leap needed to overcome the last point is crucial to understanding wave dynamics and using it to solve problems in hydraulics, design of breakwater location, and how earthquake waves move through earth. The four videos in this series features waves associated with high tide coming to shore at Labrador Park, Singapore that manifest in clear constructive and destructive interference zones. Waves breaking up into foamy water as it nears shallow land can also be observed. Hopefully, the videos would be useful for students to visualize wave dynamics and researchers seeking to understand the hydrology of Labrador Park in Singapore.

Conflicts of interest

The author declares no conflicts of interest.

Author's contribution

The author saw the waves coming onto shore and observed the breaking up of wave crests into foamy water, which resembles a mini tsunami. Hence, an idea came to mind to capture a few videos that helps illustrates dynamic constructive and destructive interference in water waves. Seah Kwi Shan contributed to the formulation of the title of this preprint. Ng Wenfa wrote the short description.

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