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Invisibility Cloaking to Shield Floating Objects from Waves

San Diego, Calif., Nov. 19 – A new approach to invisibility cloaking may one day be used at sea to shield floating objects – such as oil rigs and ships – from rough waves. Unlike most other cloaking techniques that rely on transformation optics, this one is based on the influence of the ocean floor's topography on the various "layers" of ocean water.

At the American Physical Society's (APS) Division of Fluid Dynamics (DFD) meeting, held Nov. 18-20 in San Diego, Calif., Reza Alam, assistant professor of mechanical engineering at the University of California, Berkeley, will describe how the variation of density in ocean water can be used to cloak floating objects against incident surface waves.

"The density of water in an ocean or sea typically isn't constant, mainly because of variations in temperature and salinity," explains Alam. "Solar radiation heats the upper layer of the water, and the flow of rivers and the melting of ice lowers the water density near the surface. Over time, these effects add up to form a stable density stratification of two layers – with the lighter fluid layer on top and the more dense fluid layer below it."

Stratified waters, much like regular surface waves, contain "internal waves," which are gravity waves that propagate between the two layers of water. For the same frequency of oscillation, however, internal waves travel at a much shorter wavelength and slower speed than surface waves.

Both wave types "feel" the ocean floor's influence, which generates an energy transfer.

Zeroing in on this energy transfer, Alam used computer simulations to transform a surface wave into internal wave as it approaches an object – meaning that the wave will pass beneath the object rather than crashing into it. And once the internal wave moves beyond the object, it can be transformed back into a surface wave.

This would be achieved by creating "corrugations" or wavy ripples that are tuned to a specific wavelength on the ocean floor in front of the floating object to be cloaked.

"Cloaking in seas by modifying the floor may play a role in protecting near-shore or offshore structures and in creating shelter for fishermen during storms," says Alam. "In reverse, it can cause the disappearance and reappearance of surface waves in areas where sandbars or any other appreciable bottom variations exist."

Presentation: "A Cloak of Invisibility Against Ocean Waves," is at 10:43 a.m. on Monday, Nov. 19, in Room 32A.
Abstract: http://meeting.aps.org/Meeting/DFD12/Event/178356

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MORE MEETING INFORMATION
The 65th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics will take place from November 18-20, 2012, in San Diego, Calif. It will bring together researchers from across the globe to address some of the most important questions in modern astronomy, engineering, alternative energy, biology, and medicine. All meeting information, including directions to the Convention Center, is at: http://apsdfd2012.ucsd.edu/

USEFUL LINKS
Main Meeting Web Site: http://apsdfd2012.ucsd.edu/
Searchable Abstracts: http://meeting.aps.org/Meeting/DFD12/APS_epitome
Directions and Maps: http://apsdfd2012.ucsd.edu/?page=Venue_and_Maps

PRESS REGISTRATION
Credentialed full-time journalists and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference free of charge. If you are a reporter and would like to attend, please contact Charles Blue (dfdmedia@aps.org, 301-209-3091).

SUPPORT DESK FOR REPORTERS
A media-support desk will be available. Press announcements and other news will be available in the Virtual Press Room (see below).

VIRTUAL PRESS ROOM
The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will feature news releases, graphics, videos, and other information to aid in covering the meeting on site and remotely. See: http://www.aps.org/units/dfd/pressroom/index.cfm

GALLERY OF FLUID MOTION
Every year, the APS Division of Fluid Dynamics hosts posters and videos that show evocative images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries are selected for their artistic content, originality, and ability to convey information. They will be honored during the meeting, placed on display at the 2013 APS March Meeting, and appear in the annual Gallery of Fluid Motion article in the American Institute of Physics' journal, Physics of Fluids.

Selected entries from the Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

This release was prepared by the American Institute of Physics (AIP) on behalf of the American Physical Society's (APS) Division of Fluid Dynamics (DFD).

ABOUT THE APS DIVISION OF FLUID DYNAMICS
The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: http://www.aps.org/units/dfd/