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Direct computational experiment in storm hydrodynamics of marine objects

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The paper presents and discusses a new computer toolkit for assessing the seaworthiness of a ship in stormy sailing conditions, intended for testing new design solutions for promising ocean-going ships and ships of unlimited ocean navigation, as well as organizing full-function simulators. The presented toolkit can be used by captains to select effective and safe sailing modes, as well as to train personnel.
A modern computational experiment allows direct modeling of intense sea waves, which fully recreates the hydromechanics of external influences on the ship, and ensures its full positioning relative to the crests of storm waves. Such experiments require the use of high-performance computing technology based on GPGPU, as well as distributed data preparation and processing. Parameters of three structures of real sea waves, including extremely high heights, are determined as the initial conditions for modeling. The ship also possesses real dynamic characteristics, and she is capable to go by arbitrary courses in relation to waves. The possibility of dynamically changing the parameters of the ship during the experiment is provided. It is required to assess the motion state in various cases of ship loading, including emergency.
The most important feature of the software is a full-fledged three-dimensional visualization of all storm waves, as well as the spatial position and trajectory of the ship and its parameters. A special experimental environment for engineering surveys for projected ships is created using the graphical tools of OpenGL.
This computer toolkit is considered within the framework of the concept of a virtual testbed.

Summary

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