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COLLOQUIUM

JEREMY HOSKINS

Department of Statistics, Computational and Applied Mathematics,
University of Chicago

On thin ice: integral equations for linear flexural-gravity waves

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Jones 303, 5747 S. Ellis Ave. Chicago, IL 60637

ABSTRACT

Waves in thin elastic sheets, such as plates and membranes, arise in many settings, notably in the study of sea ice and ice shelves. When floating on water, such sheets also alter the dynamics of surface waves, with applications at scales ranging from laboratory experiments to polar oceans. In this talk, we first consider a thin plate with a free edge and propose a new, well-conditioned integral equation formulation that treats general plate geometries accurately and efficiently. We then turn to deep water partially covered by a floating plate or membrane with one or more holes. Here, the sheet enters as a boundary condition on the water's surface, involving second order surface derivatives for a membrane and fourth order for a plate. This condition changes abruptly across the edges of the sheet, which makes these problems difficult to solve numerically, especially when the holes are irregularly shaped. We present a general integral equation approach for this class of problems, along with fast numerical methods that handle arbitrary shapes. Through several examples, we show that these methods are robust and scale well. Finally, we discuss extensions to other types of waves.

Organizers:

Guillaume Bal, Department of Statistics (CCAM), guillaumebal@uchicago.edu & Nisha Chandramoorthy, Department of Statistics (CCAM), nishac@uchicago.edu, Eitan Levin, Department of Statistics (CCAM), sanzalonso@uchicago.edu
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