PHYSICAL MATH SEMINAR

Water Entry of a Simple Harmonic Oscillator

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ABSTRACT:

When a blunt body impacts an air-water interface, large hydrodynamic forces often arise, a phenomenon many of us have unfortunately experienced in a failed dive or ``belly flop.'' Beyond assessing risk to biological divers, an understanding and methods for remediation of such slamming forces are critical to the design of numerous engineered naval and aerospace structures. Herein we systematically investigate the role of impactor elasticity on the resultant structural loads in perhaps the simplest possible scenario: the water entry of a simple harmonic oscillator. Contrary to conventional intuition, we find that ``softening'' the impactor does not always reduce the peak impact force on the trailing body, but may also increase the force as compared to a fully rigid counterpart. Through our combined experimental and theoretical investigation, we demonstrate that the transition from force reduction to force amplification is delineated by a critical hydroelastic factor that relates the hydrodynamic and elastic timescales of the problem. I will also discuss our ongoing work on the development of a untethered cyber-physical impactor, CyberDiver, which permits specification of an arbitrary structural coupling in software while still being exposed to the complete set of fluid physics.

TUESDAY, May 6, 2025

2:30 PM – 3:30 PM

Building 2, Room 361

Note change in location

MIT MATHEMATICS

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