Keynote

Wed. Nov 11, 2026 2:00 PM - 3:30 PM JST | Wed. Nov 11, 2026 5:00 AM - 6:30 AM UTC | Room A (Oshidori) (2F)

Keynotes A1

Chair: Marina Tonani, Fei Chai

2:00 PM - 2:15 PM JST | 5:00 AM - 5:15 AM UTC

[_yrsOa95-01] Real time Bayesian inversion, prediction, and OED for tsunami early warning

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We address real-time Bayesian inverse problems governed by time-shift-invariant wave equations, with particular focus on tsunami source inversion and forecasting, and sensor network optimal experimental design. Efforts are underway to instrument subduction zones with ocean bottom acoustic pressure sensors to provide tsunami early warning. Our goal is to create a physics-based early-warning system that employs this pressure data, along with the 3D coupled acousticâ€“gravity wave equations, to infer the earthquake-induced spatiotemporal seafloor motion in real time. The Bayesian solution of this inverse problem then provides the seafloor forcing to forward propagate the tsunamis toward populated areas along coastlines and issue forecasts with quantified uncertainties.

In the context of the Cascadia Subduction Zone, a single forward wave propagation requires ~1 hour on a supercomputer. The Bayesian inverse problem, with a billion uncertain parameters, formally requires hundreds of thousands of adjoint wave propagations; thus real time inference appears to be intractable. We propose a novel approach to enable exact solution of the inverse and prediction problems in real time. The key is to exploit the time-shift-invariance of the parameter-to-observable map, which permits FFT diagonalization and fast GPU implementation. The result is that tsunami inverse problems with a billion parameters can be solved exactly in a fraction of a second.
This fast Bayesian inversion capability is then exploited to solve the optimal experimental design problem of placement of seafloor pressure sensors to maximize expected information gain in predictive quantities of interest. Time permitting, we discuss data-driven prior construction, goal-oriented dimension reduction, and construction of fast surrogates for the nonlinear shallow water equations, which are needed for representing nearshore tsunami dynamics.

This work is joint with Stefan Henneking, Sreeram Venkat, Bowen Shi, and Yuhang Li at UT Austin, and Alice Gabriel at UCSD.

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