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Synthetic LISA: simulating the future of LISA data analysis

The NASA/ESA Laser Interferometer Space Antenna (LISA) will extend the reach of ground-based detectors to entirely new classes of gravitational-wave sources, allowing unprecedented astrophysical studies and high-precision tests of general relativity. It will also introduce new and peculiar complications in the reduction and analysis of experimental data, such as the suppression of laser phase noise by several orders of magnitude, the nontrivial signal and noise transfer functions, and the resolution of many simultaneous continuous signals. I discuss the status and the outstanding challenges of LISA data analysis and detector characterization, and I explore the role of simulation in developing and testing new strategies and techniques. Last, I describe the current efforts to plan the development and implementation of data-analysis techniques and systems.

Title : Obtaining astrophysically relevant gravitational waveforms from numerical relativity simulations.

Abstract: Recent advances in numerical relativity simulations of binary black holes and binary neutron stars have made it possible to seriously consider using extracted waveforms in signal searches and parameter estimations in gravitational wave detectors.
By obtaining error estimates for my neutron star inspiral simulations, I will show how one can verify the numerically induced errors in an extracted gravitational waveform to be less significant than the noise characteristics of any particular gravitational wave detector.

TITLE:
Seismic wave propagation in heterogeneous media: Modeling, signal processing and inversion

ABSTRACT
Seismic wavefield imaging is a powerful tool to image the interior of the Earth. Although the physics and mathematics of wavefield propagation are fairly well understood, in many cases the simplifying assumptions involved in seismic imaging (i.e. the inverse problem) limit the applicability of current imaging technology to cases where the Earth structure is well-behaved.
That is, areas where the Earth has a propensity of horizontal layering, macro-scale structure that is amiable to discrete mapping, and relatively small impedance fluctuations. However, most of the Earth does not follow these rules, so we must consider a new paradigm of wavefield inversion. In the case where the Earth is relatively heterogeneous, we can create 'effective stochastic models' that mimic certain textural aspects of the Earth. Given these models, we can then make progress on wavefield modeling and inversion techniques. In this talk, I will discuss our current efforts on this front, which involve aspects of simulation and modeling of fractal models of Earth texture, model-based signal processing, and wavefield inversion. The application of these techniques include new tools for interpretation and new model-based deconvolution schemes.