Observational signatures for extremal black holes

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I will present observational signatures for extremal black holes. These signatures rely on the precise late time asymptotics for solutions to the wave equation on such backgrounds. I will also present asymptotics for subextremal backgrounds.

Inferring dependencies and reduced order models in geophysical datasets with applications to uncertainty quantification and prediction

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Geophysical datasets are characterized by unique challenges: multiple scales in space and time, strong nonlinear coupling of dynamical components, and a large number of positive Lyapunov exponents, i.e. instabilities. These properties make the prediction and uncertainty quantification in geophysical settings a problem of unique complexity. Contemporary ocean, atmospheric and climate models aim to overcome these challenges by accurate numerical discretization of the governing equations, careful parameterizations, and/or data-assimilation schemes. However, the resulting models are typically very complex, expensive and often with important uncertainties due to the large number of underlying parameters. In this work we present a machine learning framework that aims to first infer dependencies within a reduced set of variables and then integrate these functional relationships in the context of reduced order stochastic modeling. Our approach is based on a machine-learning framework that naturally 'splits' the dynamics into a predictable part, which can be effectively parametrized in terms of the considered state variables, and a stochastic residual, which cannot be uniquely determined using the considered state variables. The latter is represented using a conditionally Gaussian process, a choice that allows us to overcome the need for a vast amount of training data, which for geophysical problems, is naturally limited to a single realization for each spatial location. We demonstrate the approach on two problems: i) the stochastic reconstruction of small-scale features in coarse atmospheric datasets for modeling spatial extremes, and ii) the modeling of the 3D ocean temperature field using only real-time information for the sea surface temperature.

Exact Mixed-Integer Programming Approach for Chance-Constrained Multi-Area Reserve Sizing

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An exact algorithm is developed for the chance-constrained multi-area reserve sizing problem in the presence of transmission network constraints. The problem can be cast as a two-stage stochastic mixed integer linear program using sample approximation. Due to the complicated structure of the problem, existing methods attempt to find a feasible solution based on heuristics. Existing mixed-integer algorithms that can be applied directly to a two-stage stochastic program can only address small-scale problems that are not practical. We have found the minimal description of the projection of our problem onto the space of the first-stage variables. This enables us to directly apply more general Integer Programming techniques for mixing sets, that arise in chance-constrained problems. Our method can tackle real-world problems. We specifically consider a case study of the 10-zone Nordic network with 100,000 scenarios where the optimal solution can be found in approximately 5 minutes.