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Sequential sampling with heteroscedastic surrogate model to quantify extreme response statistics XIANLIANG GONG, YULIN PAN, University of Michigan, FLOW PHYSICS AND ENGINEERING LAB TEAM — We consider a dynamical system with two sources of uncertainties: (1) parameterized input with known probability distribution, and (2) stochastic input-to-response (ItR) map. Our purpose is to efficiently quantify the extreme response statistics when the ItR map is expensive to compute (so a full Monte-Carlo approach is not affordable). This problem setup arises often in physics and engineering, such as weather forecasting and ship motion in irregular wave fields (where the stochasticity in ItR can come from the uncertain subgrid processes and initial conditions in simulation for each input). Our approach in essence leverages sequential sampling in the input parameter space, and accounts for the stochastic ItR map through the heteroscedastic Gaussian process regression (HGPR). A sequential sampling (i.e., next-best sampling) criterion is developed which minimizes the required number of samples to achieve accurate resolution of the extreme response statistics. We demonstrate the effectiveness of the current approach with multiple examples including the ship motion response problem.

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