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A Comprehensive, Efficient, and Robust Approach for Global Sensitivity Analysis

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This presentation outlines features, capabilities, and recent developments of VARS (Variogram Analysis of Response Surfaces), which is a general framework for Global Sensitivity Analysis (GSA). VARS utilizes the variogram/covariogram concept to characterize the full spectrum of sensitivity-related information, thereby providing a comprehensive set of "global" sensitivity metrics with minimal computational cost. VARS is unique in that, with a single sample set (set of simulation model runs), it generates simultaneously three philosophically different families of global sensitivity metrics, including (1) variogram-based metrics called IVARS (Integrated Variogram Across a Range of Scales - VARS approach), (2) variance-based total-order effects (Sobol approach), and (3) derivative-based elementary effects (Morris approach). VARS is also enabled with two novel features; the first one being a sequential sampling algorithm, called Progressive Latin Hypercube Sampling (PLHS), which allows progressively increasing the sample size for GSA while maintaining the required sample distributional properties. The second feature is a "grouping strategy" that adaptively groups the model parameters based on their sensitivity or functioning to maximize the reliability of GSA results. These features in conjunction with bootstrapping enable the user to monitor the stability, robustness, and convergence of GSA with the increase in sample size for any given case study. VARS has been shown to achieve robust and stable results within 1-2 orders of magnitude smaller sample sizes (fewer model runs) than alternative tools.