SURROGATE MODELING OF HIGH-DIMENSIONAL RESPONSE SURFACES WITH STEEP GRADIENTS

Pieterjan Robbe[1], *Habib N. Najm*[1]

[1]*Sandia National Laboratories*

ABSTRACT

In this talk, we present a novel benchmark problem for surrogate modeling of high-dimensional response surfaces with steep gradients. Such problems arise, for example, in the context of phase field simulations for predicting fission gas release in uranium oxide nuclear fuel. The fission gas occupies intragranular bubbles, that diffuse along the grain boundaries. The interface between the gas bubbles and the fuel grains is modeled with a phase field, using a distinct order parameter associated with phase. When modeling the gas content at a fixed mesh location, the order parameters, in the sharp interface limit, lead to steep gradients in the parameter space. These steep gradients indicate a complex nonlinear underlying process, making it difficult to develop accurate surrogate models using classical techniques that exploit a smoothness assumption, such as polynomial chaos expansions. This becomes even more challenging in high dimensions, where training data is increasingly sparse. A partial solution will be presented that relies on an adaptive sampling scheme and radial basis functions.