Tim Wildey

A Low Fidelity Approach for Efficient Uncertainty Quantification of High Fidelity Models

1 University Station C0200
Austin
Texas 78712
twildey@ices.utexas.edu
Hector Klie
Mary F. Wheeler

A fundamental difficulty in understanding and predicting large-scale fluid movements in porous media is that these movements depend upon phenomena occuring on small scales in space and/or time. The differences in scale can be staggering. Aquifers and reservoirs extend for thousands of meters, while their transport properties can vary across centimeters, reflecting the depositional and diagenetic processes that formed the rocks. In turn, transport properties depend on the distribution, correlation and connectivity of micron sized geometric features such as pore throats, and on molecular chemical reactions. Seepage and even pumped velocities can be extremely small compared to the rates of phase changes and chemical reactions. Thus, in subsurface modeling, it is physically impossible to incorporate the exact values of certain parameters at every point in the reservoir into the numerical model. To account for this uncertainty, these parameters are often treated as random variables rather than deterministic quantities. As a result, the statistics of the flow variables over a large number of simulations becomes of primary interest. We explore the use of low fidelity models to quantify uncertainty in more complicated, high fidelity models and present an efficient uncertainty quantification approach for nonlinear compressible multiphase flow in porous media. We illustrate our approach with numerical examples.