**Local-Global Multiscale Model Reduction for History Matching and Optimization in Heterogeneous Porous Media Flow.**

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**ABSTRACT:** The development of efficient, accurate and robust numerical reservoir simulation it a key step in devising advanced production optimization strategies and uncertainty quantification methods in heterogeneous porous media flow. To this end, the simulation under the uncertainty paradigm can be gauged by simulating a number of different scenarios, and very often, thousands of such runs may be required to cover the entire parameter spaces leading to unfeasible computational implementation. Therefore, the ability to coarsen these highly resolved models to levels of details appropriate for simulations, optimization, and uncertainty quantification, while maintaining the integrity of the model for its fast simulation is clearly needed. In principle two pathways can be followed: (1) coarsening certain parts of the discrete model of the underlying PDE's, and (2) reduction in the number of state variables in a process called model reduction. These paradigms have been tested in many instances in different frameworks, but they have never been consolidated in a common basis. This talk will describe a local-global model reduction method that combines both pathways in an efficient way. The balanced truncation method will be used to show the interplay between a local reduction in a multiscale framework and a global reduction as in the input-output framework.