Model Order Reduction in Porous Media Flow

Speaker: Eduardo Gildin, Texas A&M

Friday October 21, 2011
3:00 PM- 4:00 PM

Bioscience Complex, Rm 2.168

Abstract.

The development of efficient numerical reservoir simulation is an essential step in devising advanced production optimization strategies and uncertainty quantification methods applied to porous media flow. In this case, highly accurate and detailed descriptions of the underlying models lead to a solution of a set of partial differential equations, which after discretization, induce dynamical systems of very large dimensions. In order to overcome the computational costs associated with these large-scale models, several forms of model-order reduction have been proposed in the literature. In porous media flow, two different approaches are used: (1) a "coarsening" of the discretization grid in a process called upscaling and multiscale methods; and (2) a reduction in the number of state variables (i.e., pressure and saturations) directly in a process called approximation of dynamical systems. Recently, the idea of combining both approaches has been proposed using the multiscale formulation combined with balanced truncation.

In this talk, I will motivate the use of reduced-order modeling for mitigating the computation cost in reservoir production optimization, and in particular for the concept of closed-loop reservoir management. I will then describe the model reduction methods in a systems framework and will show their applicability in optimization and uncertainty quantification. Several methods will be discussed in the linear and nonlinear settings and the connections to multiscale methods will be proposed.

Biosketch:

Dr. Eduardo Gildin is an Assistant Professor of Petroleum Engineering at Texas A&M University and holder of the CJ Craft Jr. Faculty Fellowship in Petroleum Engineering. Dr. Gildin holds a PhD in Aerospace Engineering from the University of Texas at Austin and has held Postdoctoral Fellowships from The Institute for Computational Engineering and Sciences (Center for Subsurface Modeling) at The University of Texas at Austin and from the Electrical and Computer Engineering at Rice University. As a lecturer, he has taught undergraduate classes on Control Systems and Flight Dynamics and Applied Reservoir Simulation, and graduate classes on Model Order Reduction, Finite Element Methods, and Advanced Reservoir Simulation.
Dr. Gildin has research interests in reservoir modeling and optimization for the oil and gas industry, namely the closed-loop reservoir management framework, using concepts from mathematical modeling using discretization of pde’s (finite difference, finite element methods, and finite volumes), systems and control theory and model reduction of large scale dynamical systems.