

# Reconciling High-Resolution Reservoir Models to Production Data Using Streamline Simulation

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**Datta-Gupta, Akhil**

Petroleum Engineering, Texas A&M University, College Station, Texas

## **Abstract**

Recent developments in reservoir characterization and in the management of uncertainty have lead to the ability of the petroleum industry to routinely generate large multimillion-cell detailed geologic models. Reconciling such high-resolution models to dynamic reservoir behavior (transient pressure and tracer response, multiphase production history) still remains an outstanding challenge because of the high computational cost associated with the solution of large inverse problems. Streamline-based flow simulation models can offer significant potential in this regard.

In this presentation we will exploit an analogy between streamlines and seismic ray tracing to develop an efficient formalism for history matching and performance forecasting using high-resolution reservoir models. Utilizing concepts from the asymptotic ray theory in seismic and diffusive electromagnetic imaging, we will generalize the streamline approach to handle a wide variety of reservoir conditions including primary depletion and compressible flow. Production data integration is then carried out in a manner analogous to seismic tomography and waveform imaging by first matching the “arrival time” and then the “amplitude” of the production response. The power and versatility of our approach will be illustrated using synthetic examples that utilize transient pressure, tracer and multiphase production history. Several field examples from the oil field and environmental applications will demonstrate the practical feasibility of the approach.