Physics Colloquium, St. Francis Xavier University

Wednesday 21 November 2018 at 4pm

SCHW 156

Dr. Oleg Volkov

Stanford University, California

Computational techniques for solving inverse problems in geosciences

Computational optimization methods are increasingly being applied in subsurface engineering disciplines such as geothermal/groundwater resources management, carbon dioxide sequestration and hydrocarbon field development with a goal to ensure risk-averse and sustainable use of earth, energy resources, and environment.

I review computational techniques designed and employed in our research group and discuss their use in the context of two inverse problems: history matching and optimal well placement.

History matching for uncertainty quantification is typically formulated under a Bayesian framework, which entails defining the prior distribution of model parameters to be calibrated. For practical problems, however, our prior knowledge about the subsurface geological information may be incorrect, or inconsistent with the true geology. Such inconsistency may result in calibrated models that have poor match with observed data, or even in cases when the model outputs have acceptable match with observed data, the corresponding predictions may be unreliable.

Optimal well placement problem formulations typically involve nonconvex solution spaces resulting from realistic geological and engineering nonlinear constraints.

Commonly, optimization procedures rely on time-consuming subsurface fluid flow simulations for objective function calculation. Complex nonconvex solution spaces coupled with computationally expensive cost function evaluations require efficient constraint handling approaches to retain search efficiency and avoid poor solution sampling.