Chemical & Physical Sciences
UNIVERSITY OF TORONTO
MISSISSAUGA

COLLOQUIUM SEMINAR SERIES

CONTROLLING NATURAL RESOURCE OPERATIONS USING GEOPHYSICAL MEASUREMENTS AND DEEP REINFORCEMENT LEARNING

featuring Andrei Swidinsky
Associate Professor &
Teck Chair in Exploration Geophysics
University of Toronto

Stochastic control is concerned with optimal decision-making in the presence of uncertainty. One approach to solving such control problems is deep reinforcement learning (DRL), which, along with supervised and unsupervised learning, is one of the three main categories of machine learning. DRL agents learn optimal behaviour through repeated interaction with their surrounding environments, and have achieved human-level performance in challenging domains such as algorithmic trading, navigating self-driving cars and playing classic board & video games. To date, DRL has only been sparingly used for natural resource projects but because applied geophysicists - and more generally, applied geoscientists - acquire data to make various engineering and business decisions, I posit that the machinery of DRL is an ideal match for the exploration, development, production and/or management of subsurface resources.

One key feature that differentiates DRL from other machine learning paradigms is that “time really matters”, meaning that decisions are made on-line according to the current situation (such as each move on a chess board). Various geoscientific applications like geothermal energy production, groundwater management or geological carbon storage can benefit from such on-line sequential decision-making for optimal well placement or flow control, and time-lapse geophysical measurements – like gravity, electromagnetics or seismic – can be key inputs for this process. Likewise, optimal exploration strategies for net-zero technology-enabling commodities such as critical minerals also require sequential decisions concerning what type of data to collect as exploration proceeds. In this talk I will outline the efforts of my research program at the University of Toronto in applying DRL to subsurface resource problems, first through fundamental concepts and subsequently by a few illustrative optimal control examples.

Wednesday, March 26, 2025 | 3:15pm

Location: CC3150