Seminars

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This page presents work in progress research seminars that are held weekly. These seminars carry on Machine Learning and Bayesian based methods applied to civil engineering. All seminars are open to the public.

Previous seminars : 2016-2017 | 2017-2018 | 2018-2019 | 2019-2020 | 2020-2021

Dec 15 2022 15:00 | Polytechnique Montreal
Presenter: Zachary Hamida | Postdoc, Polytechnique Montreal
Title: Quantifying the Cost of Delaying Maintenance Actions on Transportation Infrastructure.
Abstract: Maintenance delays are common due to budgetary and resources constraints. This talk presents a formulation for quantifying the cost of delayed maintenance on bridges. The proposed method represents a useful tool for decision makers to determine the priority of maintenance for each bridge.

Dec 8, 2022 15:00 | Polytechnique Montreal
Presenter: James-A Goulet | Professor Polytechnique Montreal
Title: Separating epistemic and aleatory uncertainties using conditional Bayesian model selection.
Abstract: The limitations of Bayesian model selection are two-fold: first, the posterior probability mass function (PMF) of models typically wrongfully concentrates the probability mass on a single model, and second this PMF obtained varies greatly across datasets. The hypothesis we will explore in this seminar is that the root cause for these two limitations is the same: the inclusion of the aleatory uncertainties in the likelihood calculations. In practical cases, the variability in the likelihood values induced by the aleatory uncertainties tends to dominate the difference in likelihood between models. As a consequence the likelihood of the aleatory uncertainty wrongfully concentrates the probability content on a single model and induces a large variability across datasets. We will see how the new conditional Bayesian model selection (CBMS) formulation allows separating epistemic and aleatory uncertainty sources so that we represent the posterior PMF of models while excluding aleatory uncertainties from the marginal likelihood calculations. Through the seminar, we will compare the BMS and CBMS methods on case-studies applied on state-space models and Bayesian neural networks.

Nov 17, 2022 15:00 | Polytechnique Montreal
Presenter: Shervin Khazaeli | Ph.D student, Polytechnique Montreal
Title: Damage Detection for Structural Health Monitoring Using Reinforcement and Imitation Learning.
Abstract: Thesis defense reherseal.

Nov 3 2022 15:00 | Polytechnique Montreal
Presenter: Bhargob Deka | Ph.D student, Polytechnique Montreal
Title: Analytical Bayesian Parameter Inference for Probabilistic Models with Engineering Applications.
Abstract: In this seminar I will present the work that I carried out in my thesis for creating analytical Bayesian methods for inferring parameters in probabilistic models.

Oct 20 2022 15:00 | Polytechnique Montreal
Presenter: James-A. Goulet | Professor, Polytechnique Montreal
Title: Batch processing for state-space models.
Abstract: In the context of state-space models (SSM), the estimation of hidden states using the Kalman filter is an inherently sequential process. Now that we are looking into coupling recurrent neural networks (RNN) and SSM using TAGI, the computational demand for long time-series is substantially higher than for plain SSM. This seminar will present a new approximate method in order to estimate the hidden states by splitting a time series into multiple batches that can be estimated using parallel computing. In addition to presenting the new methodï¿½s formulation, we will discuss the notions related to the probability distribution resulting from the product of Gaussians and the concept of the theoretical best log-likelihood values. The performance and applicability of the new approximate method will be showcased through an applied example.

Sep 15 2022 15:00 | Polytechnique Montreal
Presenter: Shervin Khazaeli | Ph.D student, Polytechnique Montreal
Title: Anomaly detectability quantification using imitation learning.
Abstract: In this seminar we will revisit the problem of anomaly detection and quantification using imitation learning. The main difference from previous approaches based in reinforcement learning is that in the imitation learning approach the reward function is assumed to be unknown. Instead, an agent learns the optimal policy by following (imitating) and optimal policy obtained from and expert. We will examine the new anomaly detection approach on the three instrumented spans on the Jacques Cartier Bridge.

Sep 8 2022 15:00 |
Presenter: Van-Dai Vuong | Ph.D student, Polytechnique Montreal
Title: Exponential Smoothing in Bayesian Linear Dynamic Model.

Polytechnique Montreal	**Abstract**: Existing components of Bayesian Linear Dynamic Model (BDLM) are only capable of modelling monotonic trends in the data. This seminar presents the exponential smoothing component for BDLM for extracting non-monotonic trends.
Sep 1 2022 15:00 | Polytechnique Montreal	**Presenter:** Ali Fakhri | MSc. student, Polytechnique Montreal **Title**: Scalable and fast state-space models for infrastructure deterioration. **Abstract**: This seminar will present how TAGI replaces kernel regression (KR) in the network-scale state-space model (NSSM) framework for infrastructure degradation. The performance of TAGI-NSSM is compared with KR-NSSM on the synthetically generated data emulating.
Aug 25 2022 15:00 | Polytechnique Montreal	**Presenter:** Zachary Hamida | Postdoc, Polytechnique Montreal **Title**: A Hierarchical Environment for Planning Maintenance Activities on Infrastructures Using Reinforcement Learning. **Abstract**: This talk presents a hierarchical decision-making environment for infrastructures, which adapt to the hierarchy of information and decisions in maintenance planning. The hierarchical formulation enables decomposing large state and action spaces into smaller ones, by relying on state and temporal abstraction. Example applications are presented and discussed along with existing limitations.
Jun 23 2022 15:00 | Polytechnique Montreal	**Presenter:** Van-Dai Vuong | Ph.D student, Polytechnique Montreal **Title**: Coupling BDLM and LSTM and Switching Kalman Filter for Anomaly Detection. **Abstract**: This seminar presents the hybrid model which couples BDLM and LSTM. In this mode, the local level, local trend and local acceleration components are as same as those in BDLM, and the LSTM replaces the Kernel regression component to learn repeated patterns. The Switching Kalman Filter is then applied to this hybrid model in order to detect anomaly.
Jun 9 2022 15:00 | Zoom	**Presenter:** Shervin Khazaeli | Ph.D student, Polytechnique Montreal **Title**: Development of methods for the interpretation of data and the planning of the instrumentation for the Jacques Cartier Bridge. **Abstract**: In this seminar we present the results for the current project regarding the instrumentation of the Jacques Cartier Bridge. The primary objective of the project is to propose an effective measurement system design in order to maximize the detection of the anomalies, while minimizing the false ones. To this end, we propose an anomaly detection framework based on the Bayesian dynamic linear models (BDLMs) of structural responses and reinforcement learning (RL). The purpose of the framework is to quantify the anomaly detectability of each measurement system with respect to the true detections of the anomalies. Once such detection is quantified, we are able to associate the anomalies to structural damages. As a result, we can identify a sensor configuration which maximized the detectability of these damages and distinguish them.
Jun 3 2022 15:00 | Zoom	**Presenter:** Yakin Hajlaoui | Ph.D student, Polytechnique Montreal **Title**: Recent advances in Gaussian processes for solving geostatistical problems. **Abstract**: Spatial statistics, also known as Geostatistics, is a branch of applied mathematics and statistics, designed to solve the estimation of ore reserves in the mining industry in the 1950s, thanks to the work of engineer DG Krige, whose name is associated with one of the most famous techniques of geostatistics, known as Kriging. Kriging is a spatial interpolation method used for prediction problems and description of spatial variation of natural phenomena. Until now, Kriging is still one of the main interpolation algorithms used in geostatistics, and the reason is its ability to quantify uncertainty. However, Kriging suffers from its lack of dealing with big data and has strict assumptions such as the normality assumption, and the stationarity assumption. In machine learning, Gaussian Processes (GP) are very similar to Kriging and are based on the same assumptions. Unlike Kriging, the GP community made substantial developments in order to make GPs more scalable when dealing with big data by approximating them into Sparse Gaussian Processes (SGP). They resolved the stationarity problem by developing a deep structure of GP known as Deep Gaussian Processes (DGP). In this seminar, we will present the similarities and differences between Kriging and GPs and the most influential works that led to the development of SGPs and DGPs.
May 27 2022 15:00 | Polytechnique Montreal	**Presenter:** Van-Dai Vuong | Ph.D student, Polytechnique Montreal **Title**: On the comparative performances and smoother for TAGI-LSTM. **Abstract**: This presentation demonstrates how to perform smoother in TAGI-LSTM in order to infer the posteriors for the LSTM's hidden states and cell states. In this seminar, we also compare the performances of TAGI-LSTM, deterministic LSTM and variational LSTM on two time series benchmarks.
May 13 2022 15:00 | Polytechnique	**Presenter:** Shervin Khazaeli | Ph.D student, Polytechnique Montreal **Title**: Measurement System Design Using Reinforcement Learning and Cosine Similarity. **Abstract**: Measurement system design (MSD) is at the core of any structural health monitoring (SHM) system. An

Montreal	effective MSD is the one enabling a decision maker to: (i)maximize true detections of anomalies, (ii) minimize of the false alarms, and (ii) make a distinction between different type of structural damages. In this seminar we will discuss how a reinforcement learning (RL) agent in conjunction with the cosine similarity address the above-mentioned three aspects of a MSD.
Apr 29 2022 15:00 | Polytechnique Montreal	**Presenter:** Ali Fakhri | MSc. student, Polytechnique Montreal **Title**: Inferring the full heteroscedastic noise covariance matrix with TAGI-V. **Abstract**: This presentation demonstrates how we can couple the TAGI-trained neural networks with the multivariate approximate Gaussian variance inference (AGVI) to infer the full heteroscedastic noise covariance matrix. The combined framework is called TAGI-V.
Apr 22 2022 15:00 | Polytechnique Montreal	**Presenter:** James-A. Goulet | Professor, Polytechnique Montreal **Title**: Inducing sparsity in neural networks through activation functions. **Abstract**: Neural networks (NNs) involve a large number of parameters defining the relationship between hidden layers. Common applications of NNs do not take advantage of the inherent sparsity caused by the usage of the ReLU activation function. In this talk, we will show how in current fully-connected feedforward architectures, the RelU activation function leads to approximately 50% of the activated units to be zero, thus opening the door to skipping a substantial portion of the calculations. In order to further leverage the potential of sparsity, we will introduce a modified ReLU activation function that allow having >99% of the activated units for which the computations can be omitted. Inducing sparsity in NNs requires understanding the weights initialization in order to maintain the inference performance. For that purpose, we will cover the fundamental of weights initialization for TAGI-trained neural networks. The experiments with activation-induced sparsity made on a simple toy problem point towards the possibility of (1) a computational speedup from the calculations saved through the sparsity, (2) learning from a single epoch as fewer paths are activated in a sparse NN, and (3) that more work is required in order to apply the concept to more complex problems.
Apr 8 2022 15:00 | Polytechnique Montreal	**Presenter:** Zachary Hamida | Postdoc, Polytechnique Montreal **Title**: Planning Interventions for Infrastructures Using Reinforcement Learning. **Abstract**: This presentation is about the recent developments and progress in planning interventions for infrastructures. In the talk, an example toy problem and few analyses' results will be introduced, along with future work.
Mar 18 2022 15:00 | Polytechnique Montreal	**Presenter:** Bhargob Deka | Ph.D student, Polytechnique Montreal **Title**: Gaussian Multiplicative Approximation in State-Space Models. **Abstract**: In this seminar, I will present the novel approach of Gaussian multiplicative approximation to be used for multiplicative state-space models.
Mar 4 2022 15:00 | Zoom	**Presenter:** James-A. Goulet | Professor, Polytechnique Montreal **Title**: Introduction to Github. **Abstract**: This seminar provides a general overview of Github, why it will be useful for us to use it and how we will leverage its capacities.
Feb 25 2022 15:00 | Zoom	**Presenter:** Ali Fakhri | MSc. student, Polytechnique Montreal **Title**: Evaluating Reinforcement Learning algorithms in OpenAI Gym. **Abstract**: This presentation gives a brief overview of OpenAI Gym, covers the key ideas behind reinforcement learning (RL), and presents an implementation of a Monte Carlo method to solve an RL task in the OpenAI Gym.
Feb 11 2022 15:00 | Zoom	**Presenters:** Zachary Hamida | Postdoc, Blanche Laurent | MSc. student, Polytechnique Montreal **Title**: Phase 2 : Predire la degradation et comprendre l'effet des interventions. **Abstract**: This seminar presents a summary of the research work accomplished through the past year. The topics include, a general description about OpenIPDM platform, advancements in estimating the inspectors' uncertainty and the progress in planning intervention activities on a network-scale.
Feb 04 2022 15:00 | Zoom	**Presenter:** Blanche Laurent | MSc. student, Polytechnique Montreal **Title**: Analytical Inference for Inspector Uncertainty based on Network-Scale Visual Inspection. **Abstract**: This seminar presents the application of the analytical inference for inspector uncertainty based on Network-Scale Visual Inspection and its performance compared to a gradient based approach.
Jan 21 2022 15:00 | Zoom	**Presenter:** James-A. Goulet | Professor, Polytechnique Montreal **Title**: Analytically Tractable Hidden-States Inference in Bayesian Neural Networks. **Abstract**: With few exceptions, neural networks have been relying on backpropagation and gradient descent as the

inference engine in order to learn the model parameters, because closed-form Bayesian inference for neural networks has been considered to be intractable. In this paper, we show how we can leverage the tractable approximate Gaussian inference's (TAGI) capabilities to infer hidden states, rather than only using it for inferring the network's parameters. One novel aspect is that it allows inferring hidden states through the imposition of constraints designed to achieve specific objectives, as illustrated through three examples: (1) the generation of adversarial-attack examples, (2) the usage of a neural network as a black-box optimization method, and (3) the application of inference on continuous-action reinforcement learning. In these three examples, the constrains are in (1), a target label chosen to fool a neural network, and in (2 & 3) the derivative of the network with respect to its input that is set to zero in order to infer the optimal input values that are either maximizing or minimizing it. These applications showcase how tasks that were previously reserved to gradient-based optimization approaches can now be approached with analytically tractable inference.

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Jan 14 2022
15:00 | Zoom

Presenter: James-A. Goulet | Professor, Polytechnique Montreal
Title: Jira: What? Why? How?
Abstract: In this special seminar, I will present the Jira management tool. I will explain what is it, why it will be useful for us to use it and how we will leverage its capacities.

Jan 6 2022
09:00 | Zoom

Presenter: Shervin Khazaeli | Ph.D student, Polytechnique Montreal
Title: Can the agent accomplish the 'task' in hand?
Abstract: In the context of the Reinforcement Learning (RL), we let the agent to learn the 'task' in hand by interacting with the environment. The goodness of accomplishing the task is determined by a notion of a scalar signal known as 'reward': encourage the agent when it does good and/or penalize it when it does bad. In other words, we express the task in the form of reward values. But, how much expressive are the rewards? Answering this question depends on understanding different accounts of the 'task'. In this seminar we will discuss different tasks and argue that not all of the tasks are expressible by the rewards.