CIV-ML's Seminars 2016-2017

Data-Driven Pattern Recognition Model Employing Auditory Receptors for Human-Based Structural Health Monitoring System (Shervin Khazaeli, Ph.D student, Concordia University, 20/07/2017)

A quintessential conceptual element common to most Structural Health Monitoring (SHM) systems is the use of non-destructive methods and technologies to allow for the uninterrupted and efficient monitoring of structural damages. Recent advancements pertaining to the logistical underpinnings of novel damage detection SHM techniques have caused a shift from mathematical modeling of structures to pattern recognition algorithms encompassing both supervised and unsupervised learning methods. This work draws inspiration from current progressions in the field of neuroscience to incorporate the human brain in performing supervised pattern recognition, whereby the initial (i.e. damaged or undamaged) state of the structure is of prior knowledge. In this regard, the task of damage detection of a multi-story shear-building structure is carried out with the aid of Human Intelligence (HI) and Artificial Intelligence (HI) with the aid of human brain and different Machine Learning (ML) algorithms, respectively.

An Introduction to Markov Chain Monte Carlo Sampling (MCMC) (James-A. Goulet, Prof., Polytechnique Montreal, 12/07/2017)

Markov chain Monte Carlo is a method that allows drawing random samples from any functions. In the case of Bayesian estimation problems, we are interested to draw samples from the posterior probability density function. In this presentation we will se the basics principles behind the MCMC method as well as practical guidance for its efficient usage in complex problems involving a large number of dimensions.

Bond Graph based Bayesian Network (BGBN) for Damage Diagnosis in Structural Health Monitoring (Shervin Khazaeli & Laura Manolache, Ph.D student, Concordia University, 05/07/2017)

A hybrid model based on bond graph and Bayesian network âĂŞ Bond Graph Bayesian Network (BGBN) âĂŞ for damage diagnosis in the context of Structural Health Monitoring (SHM) is purposed. Here, the focus is to

embed a BG model in a BN model, that enables us to benefit from the causal properties of both models: (i) BG as a skeleton of the BN to overcome the variable ordering issue and (ii) BN as a tool dealing with variable uncertainties by virtue of monitoring-induced data. The effectiveness of the network is investigated by applying different structural measurements as evidence in order to find and rank the most probable causes.

Multi-Sensor Analysis for Bayesian Dynamic Linear Models (BDLM) (Catherine Paquin, M.Sc. Student, Polytechnique Montreal, 28/06/2017)

The objective is to find an optimal method to simplify and use the information from many sensors measuring the same object into a BDLM analysis. I'll be presenting a data set from an existing highway overpass and explore some possible methods.

A Closer Look of Switching Kalman Filter for Bayesian Dynamic Linear Models (Luong Ha Nguyen, Ph.D. student, Polytechnique Montreal, 21/06/2017)

The presentation consists in introducing the Switching Kalman Filter (SKF) theory for the Bayesian Dynamic Linear Model framework in order to detect the anomaly in the context of Civil Engineering. The SKFâĂŹs potential is illustrated on the displacement data recorded on a dam in Canada.

Genetic Algorithm Application in Computationally Demanding Problems (Zachary Hamida, Ph.D. candidate, Polytechnique Montreal, 14/06/2017)

Genetic Algorithm (GA) is a global search technique commonly used in solving different engineering problems. Since GA has no search direction, it requires a high number of iterations to guarantee convergence. This may impose difficulties in some engineering applications with high computational demand. In this presentation, different GA search frameworks (i.e. GA, HGA and GSA) will be illustrated in a context of solving reservoir-engineering problems. The computational cost in these problems arise from the need to run a simulation to compute the objective function.

On the combination of the Kalman and the particle filter (Ianis Gaudot, Post-Doc, Polytechnique Montreal, 08/06/2017)

The Kalman and the particle filter are Bayesian methods to model the underlying dynamics of a physical system. On the one hand, the Kalman filter is a fast tool that provides an optimal solution for gaussian linear problems only. On the other hand, the particle filter handles all types of problems, but it is time consuming since it relies on drawing a large number of samples to approximate the solution. There are situations where it is possible to benefit of the advantages of each technique by merging both approaches together. This presentation will discuss this hybrid method in the context of online combined state and parameter estimation.

Particle filtering for combined state and parameter estimation (Ianis Gaudot, Post-Doc, Polytechnique Montreal, 26/04/2017)

The development of a generic tool for online anomaly detection in the context of structural health monitoring of civil infrastructures involves online state and parameter estimation. This problem leads to a non-linearity that can be handled using particle filtering techniques. This seminar will present an approach which consists in augmenting the state vector space with the parameter vector. The advantages and limitations of this method will be discussed.

Online Anomaly Detection in the Behaviour of Structures - A Machine Learning Approach (Luong Ha Nguyen, Ph.D. candidate, Polytechnique Montreal, 19/04/2017)

The presentation consists of identifying the strengths and limitations of the existing methods in the literature for Structural Health Monitoring, addressing two limitations: hidden non-harmonic covariate, anomaly detection (offline procedure), and exposing the research axes in order to achieve the goal i.e. online procedure for anomaly detection.

Bayesian Model Class Comparison and Falsification (James-A. Goulet, Prof., Polytechnique Montreal, 13/04/2017)

This seminar will present the theory behind the Bayesian Model Class Comparison (BMCC). The presentation will focus on one of the potential pitfalls of this approach; it is unable to identify when initial modelling hy-

potheses are wrong. This limitation has motivated the development of a new technique called Bayesian Model Class Falsification that will be the main topic of this presentation.

Probabilistic Modeling of Laboratory Experiments on Few Replicated Specimens Using Gaussian Process Regression (Lucie Tabor, M.Sc. Student, Polytechnique Montreal, 05/04/2017)

Gaussian Process Regression is usually used on a large set of data or specimens, can it be used when only several specimens are tested? This seminar will present a method which adapts Gaussian Process Regression when the input is composed of a small number of specimens.

An Introduction to Particle Filtering (Ianis Gaudot, Post-Doc, Polytechnique Montreal, 29/03/2017)

This presentation aims at presenting the particle filtering method. We will focus on the boostrap filter algorithm, illustrated by examples in the context of structural health monitoring of civil infrastructures.

Bayesian Dynamic Linear Model Theory in the Field of Civil Engineering Part 2 (Luong Ha Nguyen, Ph.D. candidate, Polytechnique Montreal, 22/03/2017)

The goal of presentation is to provide the overall picture of Bayesian dynamic linear models (BDLMs) in the context of civil infrastructure. In the second part, we focus on the Kalman smoother theory and parameter estimation procedure.

Bayesian Estimation of Model Parameter and Prediction Errors (James-A. Goulet, Prof., Polytechnique Montreal, 15/03/2017)

This seminar will expose the limitations of deterministic model calibration and show how Bayesian estimation allows the joint estimation of model parameters and prediction errors. The theory will be presented in the context of civil engineering structures.

Probabilistic Modeling of Laboratory Experiments Using Gaussian

Process Regression with Hidden Covariates (Lucie Tabor, M.Sc. Student, Polytechnique Montreal, 01/03/2017)

This seminar will expose an extension of the standard Gaussian Process Regression applied to laboratory experiments. The aim of the method is to model the variability between tested concrete samples, unmeasured parameters are taken into account through hidden covariates and sampled from a hierarchical Bayes formulation.

Non-linear Inversion of Noise Cross-correlations using Probability Density Functions of Surface Waves Dispersion (Ianis Gaudot, Post-Doc, Polytechnique Montreal, 22/02/2017)

This seminar will present a two-step Markov chain Monte Carlo inversion method to retrieve the depth dependent elastic properties of the Earth interior from seismic data.

Bayesian Dynamic Linear Model Theory in the Field of Civil Engineering Part 1 (Luong Ha Nguyen, Ph.D. candidate, Polytechnique Montreal, 15/02/2017)

The goal of presentation is to provide the overall picture of Bayesian dynamic linear models (BDLMs) in the context of civil infrastructure. In the first part, we focus on the Kalman filter theory.