CNRS@CREATE – ESSEC Workshop
Schedule and abstracts

The workshop will take place in **Room 2C7** at ESSEC Business School, 5 Nepal Park, Singapore 139408.

The nearest MRT station is one-north MRT Station (CC23), on the Circle Line. When you reach the one-north MRT station, take Exit B and walk up Nepal Park to reach the campus. Buses: 74, 91, 92, 95, 191, 196, 198 or 200. Link: ESSEC on Google maps: `https://maps.app.goo.gl/Kfd5WjMk5aj2inPB8`

Schedule (June 11)

- 08:45–09:15 Welcome coffee.
- 09:15–09:45 ESSEC and CNRS@CREATE general introduction, by Sonja Prokopec (ESSEC Business School) and Francisco Chinesta (CNRS).
- 09:45–10:45 Scientific talks:
  - 09:45–10:15 Archan Misra (Singapore Management University) and Reetika Gupta (ESSEC Business School): *Shaping the Consumer-Centricity and Acceptance of Next-Generation Immersive-AI based Retail Technologies*.
  - 10:15–10:45 Jeremy Heng (ESSEC Business School): *Automated and Efficient Inference for Bayesian Time Series Models*.
- 10:45–11:00 Coffee break.
- 11:00–12:00 Scientific talks:
  - 11:00–11:30 Farah Benamara (CNRS): *Generative AI for Social Good: A Myth or a Reality?*
  - 11:30–12:00 Benoit Delinchant (CNRS): *Around dynamical systems identification, modelling, and optimization*.
- 12:00–13:30 Lunch break.
- 13:30–15:00 Scientific talks:
  - 13:30–14:00 Caroline Chaux-Moulin (CNRS): *Proximal approaches for Non Negative Matrix/Tensor Factorization*.
  - 14:00–14:30 Pierre Alquier (ESSEC Business School):*PAC-Bayes bounds, or understanding the generalization of Bayesian learning algorithms*.
  - 14:30–15:00 Francisco Chinesta (CNRS): *On advanced technologies for dynamical systems hybrid modelling*.
- 15:00–15:30 Coffee break.
- 15:30–16:30 Round table: synergies and future collaborations.

Scientific talks

Archan Misra (Singapore Management University) and Reetika Gupta (ESSEC Business School)

Shaping the Consumer-Centricity and Acceptance of Next-Generation Immersive-AI based Retail Technologies. *With e-commerce and online shopping continuing to grow rapidly (arguably even more due to the added impetus of the pandemic), retailers and marketers have a strong interest in fostering strong consumer experiences via online, digital platforms. This project focuses on immersive AI technologies representing next-generation retail technologies. It is unique as it combines a set of hitherto standalone technological capabilities, such as augmented reality, AI-based human instruction comprehension and big data analytics to create an immersive experience that minimises the human effort required in a single shopping episode simulating a near-human decision-making process. While building out these experiences require expertise with mobile/wearable sensing technologies and applications, the suitable design of such AR/AI-based workflows will require addressing a set of novel consumer behaviour-driven questions such as 1) What are the benefits and costs to the consumer when interacting with immersive AI technology (vs. single AI-based technologies, conventional electronic catalogues) 2) Psychological and sociological factors that influence the effectiveness of immersive-AI. 3) How can immersive-AI technologies incorporate the social/individual challenges that the consumer face during the deployment of Apps?*

We propose to investigate these research questions and test our hypotheses by designing a prototype mobile App based on such immersive-AI technology and then setting up experiments where it can be compared with other alternatives. The findings will have substantive implications for organizational learning and deployment of such technologies in the marketplace.

Jeremy Heng (ESSEC Business School)

Automated and Efficient Inference for Bayesian Time Series Models. *The use of probabilistic modelling is prevalent in scientific applications and in some social science disciplines. In this project, we focus on a very flexible class of models for time series data known as state space models (SSM) or hidden Markov models. These models have found a wide range of applications in many disciplines such as engineering, financial econometrics, neuroscience and weather forecasting. Learning the model parameters of SSMs requires marginalizing over all latent states to obtain the likelihood function. This is often a computationally challenging task in practical situations, when the dimensionality of the state space is large, the observations are highly informative or there are strong and complex nonlinear dependencies in the model. Our objective is a two-pronged approach of methodological development and practical application. Firstly, we aim to develop automated and efficient inference algorithms for SSMs that can handle all the above-mentioned regimes. Our focus on automation is crucial as we seek methods that can work well for a large class of SSMs with as little user-input as possible. Our computational approach is based on sequential Monte Carlo (SMC) methods, also commonly known as particle filters, which can provide state-of-the-art approximations. The performance of SMC is highly dependent on the choice of proposal distributions. Our motivation is to push the limits of the recently developed controlled-SMC method of (Heng et al., 2020) in challenging regimes, and further develop it for widespread user-adoption. Our strategy is to exploit various advances in machine learning to push the capabilities of state-of-the-art SMC methods. We intend to harness the flexibility of deep neural networks to construct good proposal distributions that respect the model structure of SSMs. This differs from the typical use of neural networks to directly build models and allows us to inherit its black-box nature which has been a key component of its prolific user-adoption. To develop a fully automated and efficient methodology, we will also rely on modern tools such as automatic differentiation and stochastic gradient descent, and ideas from the reinforcement learning and variational inference literature.*

Secondly, we plan to apply our proposed methodology to push the boundaries of state space modelling in three challenging application areas: epidemiological agent-based models, dynamic structural models from economics and finance, and spatio-temporal models for solar irradiance forecasting.

Farah Benamara (CNRS@CREATE)

Generative AI for Social Good: A Myth or a Reality?. *Linguistically-informed processing of unstructured textual interactions offers an important testing ground for hybrid AI and AI for social good, in particular when the attempt is to automatically understand beyond what is said. This talk is about the implicit nature of linguistic expressions investigating the role of context in their automatic processing: If humans need context, what about machines? I attempt to answer this question on three particular NLP applications: Emotion detection, Hate speech detection and crisis management. I review main findings of current studies and question the use of generative AI models in applications with great social and ethical implications for society.*

Benoit Delinchant (CNRS@CREATE)

Dynamical systems identification, modelling, and optimization applied to energy systems. *Decision-making on dynamic systems requires the implementation of a complete modelling and algorithm chain, from data sensing through digital twin to actuation. In this presentation, we will look at the key stages and issues associated with modelling and data assimilation through to optimization. We will apply this to the energy management of buildings.*

Caroline Chaux-Moulin (CNRS@CREATE)

Proximal approaches for Non Negative Matrix/Tensor Factorization. *Different approaches can be considered for solving inverse problems in signal and image processing. We considered in this work the variational formulation of the problem, which consists in seeking the solution of the inverse problem as the solution of an optimization problem. The criterion to be minimized depends not only on the observation model (data fidelity term), but also on a priori assumptions about the target solution (regularization terms, possibly expressed in a transformed domain such as the wavelet domain). Once the minimization problem has been identified, proximal approaches can be used to solve it, taking into account the mathematical properties of the terms constituting the criterion (differentiability, proximability, convexity, etc.). In this presentation, we will focus on two inverse problems. The first deals with source separation in nuclear magnetic resonance (NMR) spectroscopy, for which we have proposed an iterative algorithm to identify sources and their concentrations in different mixtures (NMF). The second addresses the problem of non-negative tensor factorization (NTF) of order N (canonical polyadic decomposition) with penalization. Based on a block coordinate forward-backward method, we have proposed a tensor decomposition algorithm and successfully applied it to fluorescence spectroscopy data.*
Blind source separation: joint work with S. Anthoine, A. Cherni and B. Torrésani under the bifrost project.
Tensor factorization: joint work with X. Vu, N. Thirion-Moreau and S. Maire.

Pierre Alquier (ESSEC Business School)

PAC-Bayes bounds, or understanding the generalization of Bayesian learning algorithms. *The PAC-Bayesian theory provides tools to understand the accuracy of Bayes-inspired algorithms that learn probability distributions on parameters. This theory was initially developped by McAllester about 20 years ago, and applied successfully to various classes of machine learning algorithms. Recently, it led to tight generalization bounds for deep neural networks, a task that cannot be achieved by standard generalization approaches such as Vapnik-Chervonenkis theory.*

In this talk, I will provide a short introduction to the PAC-Bayes theory. I will discuss a few example of successful applications, including a recent application to off-line policy evaluation in a joint work with Nicolas Chopin (ENSAE Paris) and Otmane Sahki (CRITEO).

Francisco Chinesta (CNRS@CREATE)

On advanced technologies for dynamical systems hybrid modelling. *This presentation will address informed and augmented learning technologies applied to dynamical systems modelling and simulation. Two different types of* *data-driven models will be discussed: (i) the ones that proceed by learning the dynamics itself, and then using it for performing time-integration; and (ii), the ones able to construct a regression from different experienced trajectories of the dynamical system. Special emphasis will be made on the treatment of the multiple parametric dimensions while avoiding curse of dimensionality issues, as well as the possibility (and sometimes necessity) of learning time-multi-scale dynamics.*