Minisymposium Stochastic Modeling - CNMAC 2025

Organizadores: Rubens Sampaio (PUC-Rio) e Roberta Lima (PUC-Rio)

Data do evento: $5^{\underline{a}}$ feira 18/09 (8h-10h) e $6^{\underline{a}}$ feira 19/09 (8h-10h)

Programação

Primeiro dia:

Palestrante	Palestra
Dr. Haroldo Campos	Título: "Estimating the Degree of Confidence for the
Velho	Climate Precipitation Prediction by Decision Tree Al-
	gorithm"
	Resumo: Precipitation is the hardest climate variable
	to be predicted due to its high variability in space and
	time. Machine learning (ML) approaches have got at-
	tention by the good results presented with these algo-
	rithms. We propose to perform the precipitation cli-
	mate forecasting by machine learning formulations over
	South America: decision tree (DT) and deep learning
	(DL). The DT is implemented by employing the XG-
	Boost (eXtreme Gradient Boosting) library, while DL
	strategy is a convolutional neural network type U-Net
	(a set of layers for contracting and expansion paths, vi-
	sualized as a "U" shape). For both ML predictors, the
	estimation of the quantitative confidence degree from
	predictions is based on the XGBoost algorithm. Confi-
	dence degree is determined by quantifying the variance
	linked to the forecasting: high/low variances indicate
	higher/lower forecasting confidence degrees. The uncer-
	tainty quantification of both ML predictions is evaluated
	with exact errors computed from observation data.

Palestrante	Palestra
Dr. Héctor Eduardo	Título: "Stochastic relation between runtime and dy-
Goicoechea Manuel	namical behavior of a system with uncertainties"
Goicoechea Manuel	Resumo: In this paper, a model mass-belt system with random friction is used to study the computational costs of modelling a problem with stick-slip phenomena, stochastically. The objective is to assess the link be- tween computational runtime and dynamical behaviour, specifically the duration and count of stick/slip phases. Analysing the resulting multi-dimensional random vec- tor (runtime, duration, count) is complex. This work in- vestigates random variable transformations as a method to reduce analytical complexity by creating independent variables. We also use this approach to examine the in- fluence of the integration method on the computational costs. Three different strategies to compute approxima- tions to the system solutions are compared in terms of computational runtime and their relation with the du- ration and count of stick/slip phases, the variables of greatest interest. One of the strategies used, for exam- ple, is Monte Carlo simulations coupled with a Multiple Scales analytical approximation. With this strategy, we find, for instance, that the number of stick-slip transi- tions, rather than their duration, primarily dictates the
	predictive behaviour.
Prof. Juan Carlos Cortes	Titulo: "THE IMPACT OF MEAN SQUARE CAL- CULUS TO STUDY RANDOM PARTIAL DIFFER- ENTIAL EQUATIONS: SOME INSIGHTS AND EX- AMPLES"
	Resumo: This talk invites the audience to revisit and explore the central role of the so-called random mean square calculus in addressing differential equations that incorporate uncertainty in their formulation. We will present key tools of this framework and demonstrate their application in extending classical partial differen- tial equations to the stochastic setting. The presentation will include recent theoretical developments, along with numerical examples that illustrate and support these findings.

Palestrante	Palestra
Prof. Pablo M. Ro-	Título: "Processos de ramificação aplicados ao estudo
driguez	de processos estocásticos especiais"
	Resumo: A teoria dos processos de ramificação teve
	origem a partir da análise da probabilidade de extinção
	do sobrenomes de uma família e, com o tempo, tornou-
	se uma ferramenta valiosa na modelagem de fenômenos
	físicos e biológicos. Considere um fenômeno aleatório
	onde partículas produzem novas partículas de maneira
	independente, conforme uma variável aleatória discreta
	que assume valores inteiros não negativos. Supondo que
	esse conjunto aleatório de partículas seja organizado em
	gerações — com a geração inicial composta por uma
	única partícula —, a sequência de variáveis aleatórias
	que contabiliza o número de partículas por geração con-
	stitui um processo estocástico conhecido como processo
	de ramificação. Nesta palestra, exploraremos aplicações
	recentes desses processos no estudo de diversos processos
	estocásticos especiais.

Segundo dia:

Palestrante	Palestra
Prof. R. J. Villanueva	Título: "Calibration with uncertainty of an agent-
	based model describing the transmission dynamics of
	the Respiratory Syncytial Virus"
	Resumo: Respiratory Syncytial Virus (RSV) is a com-
	mon and highly contagious virus that affects the respi-
	ratory tract. With symptoms similar to the common
	cold, it is a leading cause of lower respiratory infections
	in infants and young children. It is the primary cause of
	bronchiolitis and pneumonia in children under one year
	of age, accounting for 1.6% to 2.1% of RSV-associated
	hospitalizations in the overall population cohort. The
	Public Health impact of RSV has prompted increased
	preventive measures against this disease. For exam-
	ple, in the Valencian Community (Spain), Nirsevimab, a
	long-acting monoclonal antibody, was introduced during
	the 2023–2024 RSV season as a universal pre-exposure
	prophylaxis for high-risk infants and all children under
	6 months of age, showing a preliminary positive impact.
	Under these premises, the use of mathematical models
	is of great interest for ensuring that immunoprophylaxis
	strategies remain optimal over time and across different
	scenarios. Such models make it possible to explore al-
	ternative approaches, optimize resource allocation, and
	adapt to changes in virus dynamics or population condi-
	tions, thereby maximizing the impact on the reduction
	of pediatric hospitalizations. Before proceeding, it is es-
	sential to accurately calibrate the model to effectively
	capture both the data and the uncertainties in the dy-
	namics, given the limited information available. In this
	context, we will propose a technique for calibrating the
	model while taking uncertainty into account.
Prof. Rubens Sam-	Painel: "Presente e futuro de Modelagem Estocastica
paio (Moderador)	e Quantificação de Incertezas no Brasil"
	Panenstas: Professores Roberta Lima (PUC-Rio),
	Padio Kodriguez (UFPE), Juan Carlos Cortes e Rafael
	Villanueva (UPV, Espanha)