6th Edition of International Women in Mathematics Day 2026

Conference Program

Time	Speaker	Talk
1:15 – 1:30	Lama Tarsissi	Welcome Speech
1:30 – 2:00	Hebatallah AlSakaji	Modeling Epidemic Dynamics under Treatment Saturation and Environmental Fluctuations: A Stochastic SEIR Approach
2:00 – 2:30	Binsi Biju	*From Statistical Thinking to Modern AI: Geometry, Probability, and Intelligent Systems*
2:30 – 3:00	Eliane Younes	*AI for Grain Growth Prediction in Polycrystalline Materials*
3:00 – 3:30		**Break**
3:30 – 4:00	Aysha Nihidha	*Multiscale Analysis of a Multi-Component Plasma Model: Envelope Solitons and Modulational Instability*
4:00 – 4:30	Rasha Shat	*On Quasi-Cyclic Codes of Index 3*
4:30 – 5:00	Giulia De Masi	Women In Robotics and AI in the Middle east: echoes from a neighboring community
5:00 – 5:30	Madhurima Panja	*Space, Time, Extremes and Geometric Deep Learning*
5:30		Farewell Speech

Book of Abstracts

Modeling Epidemic Dynamics under Treatment Saturation and Environmental Fluctuations: A Stochastic SEIR Approach

Hebatallah J. Alsakaji

Department of Mathematical Sciences, College of Science, United Arab Emirates University, Al Ain, 15551, UAE

Abstract

This study explores a stochastic SEIR epidemic model that incorporates both Holling Type II treatment response and environmental fluctuations modeled by an Ornstein–Uhlenbeck process (OUP). The inclusion of stochastic perturbations allows for a more realistic representation of random environmental and epidemiological variations affecting disease transmission dynamics. By constructing suitable non-negative Lyapunov functions and applying stochastic analysis techniques, we rigorously establish the existence and uniqueness of a global positive solution to the proposed system.

Furthermore, sufficient conditions are derived to guarantee the existence of a stationary distribution when the stochastic basic reproduction number satisfies $\mathcal{R}_0^s > 1$, indicating disease persistence in the population. In contrast, criteria ensuring disease extinction are obtained when $\mathcal{R}_0^X < 1$, highlighting the threshold behavior of the system under stochastic influences. The role of the Ornstein–Uhlenbeck process in shaping the long-term dynamics of the epidemic is also discussed.

To complement the theoretical findings, a series of numerical simulations are performed. These simulations illustrate the analytical results and provide further insight into the effects of treatment saturation and environmental noise on disease spread and control. The results demonstrate that the combined impact of stochasticity and nonlinear treatment plays a significant role in determining the stability, persistence, and possible eradication of the disease.

Keywords: Ornstein–Uhlenbeck process; stochastic SEIR model; extinction; stationary distribution; Lyapunov function.

References

[1] F. A. Rihan, H. Alsakaji, and C. Rajivganthi. Stochastic SIRC epidemic model with time-delay for COVID-19. *Adv Differ Equ*, 502:https://doi.org/10.1186/s13662–020–02964–8, 2020.

[2] F. A. Rihan, H. Alsakaji. Dynamics of a stochastic delay differential model for COVID-19 infection with asymptomatic infected and interacting people: Case study in the UAE *Results in physics*. https://doi.org/10.1016/j.rinp.2021.104658.

Binsi Biju

Title: From Statistical Thinking to Modern AI: Geometry, Probability, and Intelligent Systems

Abstract:

The rapid growth of Artificial Intelligence (AI) has increased the importance of mathematics and statistics in understanding complex data and intelligent systems. Classical statistical methods such as regression, sampling, experimental design, and probability continue to play an important role, while modern AI expands these ideas into more advanced areas such as high-dimensional data, geometry, and network-based learning.

This presentation explores how traditional statistical concepts connect with modern AI methods. It discusses how linear regression relates to deep learning, how sampling ideas extend to large and high-dimensional datasets, and how experimental design principles are used in online A/B testing. The session also explains how mathematical ideas such as geometry, graph networks, and probability support real-world AI applications including recommendation systems, healthcare prediction, digital advertising, and self-driving technologies.

Using simple real-world examples, the presentation aims to show how statistical thinking continues to shape current AI research and applications.

Eliane Younes

Title: AI for Grain Growth Prediction in Polycrystalline Materials

Abstract:

Predicting microstructural evolution during thermomechanical processing remains a major challenge in computational metallurgy due to the complexity and high computational cost of traditional full-field simulations. This work investigates Artificial Intelligence (AI)-based surrogate models for fast and accurate prediction of grain growth in polycrystalline materials.

Several deep learning architectures, including recurrent neural networks (RNNs), long short-term memory networks (LSTMs), temporal convolutional networks (TCNs), and Transformer models, are explored for forecasting grain size evolution from high-fidelity simulation data. Results show that LSTM-based models provide the best balance between accuracy, robustness, and temporal stability, while significantly reducing computational cost.

The framework is further extended to non-isothermal conditions using thermally conditioned hybrid neural architectures capable of predicting grain growth under complex heating and cooling cycles. The proposed AI-driven methodologies demonstrate strong predictive performance and physical consistency, offering promising perspectives for accelerated materials design, process optimization, and intelligent manufacturing applications.

Aysha Nihidha Pulakkal, Kuldeep Singh, and Ioannis Kourakis
Mathematics Department, College of Computing and Mathematical Sciences
Khalifa University, Abu Dhabi, UAE

Multiscale Analysis of a Multi-Component Plasma Model: Envelope Solitons and Modulational Instability

Keywords: Nonlinear Schrödinger equation (NLSE), modulational instability, envelope solitons, dusty plasma, multiscale perturbation theory, kappa distribution

Abstract Nonlinear wave modulation and the emergence of localized structures are central themes in the study of dispersive nonlinear systems. In this work, we employ a multiple-scales perturbation technique to derive a nonlinear Schrödinger equation (NLSE) governing the slow modulation of electrostatic wave packets [1, 2]. The underlying model arises from a multi-component fluid system comprising several interacting species, including two distinct electron populations described by kappa distributions, which introduce significant modifications to the dispersive and nonlinear characteristics of the medium [3].

The resulting NLSE provides a framework for analyzing the interplay between dispersion and nonlinearity through explicit expressions for the associated coefficients. These coefficients depend parametrically on the underlying system parameters. A systematic asymptotic analysis is carried out in both the long- and short-wavelength regimes to examine the influence of the thermal parameter. This analysis further enables the characterization of regimes of modulational stability and instability, as well as the identification of transitions between focusing and defocusing behavior. In particular, we determine parameter domains in which the NLSE admits localized solutions, including envelope solitons and rogue-wave-type structures, associated with strong energy localization and transient extreme events [4].

Such localized excitations provide a theoretical framework for interpreting intermittent electrostatic bursts and nonlinear wave signatures observed in spacecraft measurements within Saturn's magnetosphere [5]. From a mathematical perspective, the study illustrates how variations in the underlying cold fluid model lead to qualitative changes in the structure of the reduced evolution equation and its solution space. The results contribute to a broader understanding of nonlinear dispersive equations, asymptotic reduction techniques, and mechanisms of energy localization in complex multi-parameter systems.

References

[1] M. Remoissenet, *Waves Called Solitons*, Springer, 1990.

[2] T. Dauxois and M. Peyrard, *Physics of Solitons*, Cambridge University Press, 2006.

[3] P. Schippers et al., "Multi-instrument analysis of electron populations in Saturn's magnetosphere," *Journal of Geophysical Research: Space Physics*, vol. 113, no. A7, 2008.

[4] I. Kourakis and P. K. Shukla, "Exact theory for localized envelope modulated electrostatic wavepackets in space and dusty plasmas," *Nonlinear Processes in Geophysics*, vol. 12, pp. 407–423, 2005.

[5] J. S. Pickett et al., "Electrostatic solitary waves observed at Saturn by Cassini inside 10 Rs and near Enceladus," *Journal of Geophysical Research: Space Physics*, vol. 120, no. 8, pp. 6201–6211, 2015.

Rasha Shat

Title: On Quasi-Cyclic Codes of Index 3

Abstract:

This talk studies quasi-cyclic codes of index 3 over finite fields and presents a classification of these codes. Their duals with respect to the Euclidean and Hermitian inner products are investigated, together with characterizations of self-orthogonal and dual-containing codes. We also examine structural properties of quasi-cyclic codes generated by at most three elements and provide conditions under which such codes, or their duals, are one-generator codes.

Keywords: Quasi-cyclic codes, dual codes, one-generator codes.

Giulia De Masi

Title: Women In Robotics and AI in the Middle east: echoes from a neighboring community

Abstract:

This talk presents insights from the first IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) held in the Middle East, with a focus on Women in Engineering (WIE) initiatives. A recent paper analyze qualitative evidences from the Forum on Empowering Diverse Voices in Robotics (EDVR) and a dedicated luncheon panel, and quantitative results from a targeted survey, oriented to study examines the experiences, challenges, and opportunities for women in AI and robotics in the region. Findings highlight the importance of diversity in enhancing innovation, while revealing persistent barriers.

Madhurima Panja

Title: Space, Time, Extremes and Geometric Deep Learning

Abstract:

Air quality forecasting is a vital space–time challenge with profound implications for public health and environmental management. In this talk, I will introduce E-STGCN (Extreme Spatiotemporal Graph Convolutional Networks), a novel approach that integrates graph convolutional networks with extreme value theory to predict air quality at unprecedented accuracy levels.

We will delve into the mathematical underpinnings of E-STGCN, including its ability to capture complex spatiotemporal dependencies across dynamic networks. Emphasis will be placed on how the model processes extreme events, handles multi-scale relationships, and achieves state-of-the-art results on Delhi's air quality data.