Speaker: Jon Gillard (Cardiff University)

Date: 12/12/2025 at 13:15 in 4 West 1.7 (Wolfson Lecture Theatre)

Title: Matrix completion for missing values in time series

Abstract:
Many time series exhibit strong low-rank structure when embedded into Hankel matrices, a property that underpins a wide range of techniques for approximation, denoising, and forecasting. This talk explores the mathematical and algorithmic foundations of exploiting low-rank Hankel structure for time-series analysis, with a particular focus on matrix completion. After motivating low-rank ideas through simple examples and the singular value decomposition, I introduce structured low-rank approximation for Hankel matrices and discuss its non-convexity, identifiability, and algorithmic challenges, including Cadzow iterations and their relationship to singular spectrum analysis. I then turn to structured matrix completion for forecasting, presenting convex relaxations based on the nuclear norm and highlighting when these succeed or fail. Recent theoretical results—ranging from exact recovery in rank-one settings to more general sums of exponentials—illustrate the role of damping, sampling patterns, and matrix geometry. I will also present new developments that extend completion guarantees beyond the classical "sufficiently damped" regime by column scaling strategies that recover the true structured low-rank solution. The talk concludes with practical forecasting formulations, weighting schemes, and empirical comparisons against classical methods such as ARIMA and Holt–Winters, demonstrating how structured matrix completion can deliver competitive and interpretable forecasts.