Ollscoil na Gaillimhe
University of Galway

School of Mathematical and Statistical Sciences

14th Annual Research Day

10 April 2024

Programme

	Talks take place HBB-G019 Coffee, lunch, posters, and reception take place TBA
9:20–9:30	**Cathal Seoighe**, Head of School: Opening Remarks
9:30–10:00	**Josh Maglione**, (University of Galway) *Zeta functions and hyperplane arrangements*
10:00–10:30	**Yueyun Zhu** (University of Galway) *Derivative multivariate functional principal component analysis and its application to coronary artery disease*
10:30–11:00	**Frances Fahy** (Ryan Institute) *Interrelations between mathematics and environmental research: the Role of the Ryan Institute*
11:00–11:30	**Tea and coffee**
11:30–12:00	**Griffen Small** (University of Galway) *Modelling the Non-Linear Viscoelastic Behaviour of Brain Tissue in Torsion*
12:00–13:00	**Lightning talks** person 1 • person 2 • person 3
13:00–14:10	**Lunch and Poster Session**
14:10–14:40	**Lars Jermiin** (University of Galway) *TBA*
14:45–15:30	**Eimear Byrne** (UCD) *Codes and Matroids*
15:30–17:00	**Poster session, reception, and prizes**

Contents

1 Introduction

...

Welcome to...

2 Abstracts of invited talks

Yueyun Zhu (University of Galway): *Derivative multivariate functional principal component analysis and its application to coronary artery disease*

Abstract: With the development of wearable monitoring devices and sensors, increasingly large and complex datasets are being recorded. Such data often exhibit non-linear patterns and estimating the rate of change (i.e, derivatives) is particularly informative for understanding the underlying dynamics.

Functional principal component analysis (FPCA) is a powerful tool, which represents the infinite-dimensional functional data into the Karhunen-Loève expansion with a set of orthogonal functional principal components (FPCs) and functional principal component scores (FPC-scores). Multivariate FPCA (MFPCA) is an extension of FPCA to accommodate multiple correlated features. The multivariate FPCs (MFPCs) capture the joint variation between different features and the associated multivariate FPC-scores (MFPC-scores) summarize this variation as numerical values.

To estimate the derivatives of multivariate functional data, we proposed a new method, namely the derivative of multivariate functional principal component analysis (DMFPCA). Analogously to MFPCA, the derivative MFPCs (DMFPCs) capture the joint variation for the derivatives of different features and the derivative MFPC-scores (DMFPC-scores) summarize this joint variation as numerical values.

We applied MFPCA and DMFPCA to the quantitative flow ratio (QFR) and vessel diameter obtained from angiograms. MFPCA was employed to estimate MFPC-scores, which were used as predictors in a penalized logistic regression to classify physiological patterns of coronary artery disease. DMFPCA was employed to investigate the underlying dynamics between diameter and QFR, providing guidance for selecting the optimal stent location during percutaneous coronary intervention.