



Contribution ID: 48

Type: **not specified**

Predicting Target Levels from Sensor Functional Data for Decision Making

In today's industrial landscape, effective decision-making increasingly relies on the ability to assess target ordinal variables - such as the degree of deterioration, quality level, or risk stage of a process - based on high-dimensional sensor data. In this regard, we tackle the problem of predicting a ordinal variable based on observable features consisting of functional profiles, by introducing a novel approach called functional-ordinal Canonical Correlation Analysis (foCCA). FoCCA, routed in Functional Data Analysis, enables dimensionality reduction of observable features while maximizing their ability to differentiate between consecutive levels of an ordinal target variable. FoCCA embeds the functional signal in a suitable functional Hilbert space, and the ordinal variable in the Guttman space. This approach allows the model to capture and represent the relative differences between consecutive levels of the ordinal target while explaining these differences through functional features. Extensive simulations show that foCCA outperforms existing state-of-the-art methods in terms of prediction accuracy in the reduced feature space. A case study involving the prediction of antigen concentration levels from optical biosensor signals further demonstrates foCCA's superior performance, offering both an enhanced predictive power and a wider interpretability compared to competing methods.

Special/ Invited session

Classification

Both methodology and application

Keywords

FDA, Ordinal, Sensors

Primary authors: PATANÈ, Giulia (Politecnico di Milano); Prof. NICOLUSSI, Federica (Politecnico di Milano); Dr KRAUTH, Alexander (University of Tuebingen); Prof. GAUGLITZ, Guenter (University of Tuebingen); Prof. COLOSIMO, Bianca Maria (Politecnico di Milano); Prof. DEDE', Luca (Politecnico di Milano); Prof. MENAFOGLIO, Alessandra (Politecnico di Milano)

Presenter: PATANÈ, Giulia (Politecnico di Milano)

Track Classification: Statistical/Stochastic Modelling