

Seminário / Research Seminar

An innovative Machine Learning-based approach to predict the maintenance of complex turbomachines

Jean-Loup Loyer

Jet engines rank amongst the most complex machines ever built and are governed by deterministic and stochastic phenomena. Since jet engines are subject to extremely demanding operating conditions, a proper maintenance is critical to ensure high safety, maximum availability and minimum lifecycle costs. The deterioration of a turbomachine is a prime example of a complex stochastic process that is particularly challenging to model. During its lifetime, a jet engine can indeed be damaged by random events related to internal malfunctions (part failure, design or manufacturing error...) or to the environment the engine is operating into (bird ingestion, lightning strike, particles in the air, type of route...). To monitor the health of thousands of engines currently in operation, dozens of sensors measure in real-time hundreds of engine parameters (temperature, pressure, vibration, shaft rotation speeds...). This vast amount of data can be used as inputs for complex statistical models of engine deterioration. The short seminar will focus on some machine learning-related aspects explored during a PhD thesis held at the Instituto Superior Tecnico in partnership with MIT and Rolls-Royce plc. We will succinctly describe an innovative approach of predictive maintenance in which the output variable is the scrap rates of engine components and the predictors are hundreds of features extracted from the aforementioned engine parameters. The usual steps of the statistical approach will be covered: problem formulation, model identification, dataset structure, techniques for dimensionality reduction and statistical learning algorithms. Simplified results, comparison of the performance of various Machine Learning models and challenges for future research will also be presented. Active participation of the audience is encouraged in order to identify relationships with other fields of application in Machine Learning (Chemical Engineering, Natural Language Processing, biostatistics, financial engineering, marketing...).

Bio: Jean-Loup Loyer received a M.Sc degree in Aerospace engineering from the Institut Supérieur de l'Aéronautique et de l'Espace Toulouse and Imperial College London in 2007 and a M.Sc degree in computational statistics from the University of Toulouse. As part of his PhD thesis, he is developing advanced statistical models to predict the maintenance of jet engines. He is affiliated to the Industrial Management group of the Department of Mechanical Engineering at the Instituto Superior Técnico, under the supervision of Elsa Henriques.

Where? Department of Chemical Engineering, Anfiteatro Nobre (Piso -2)

When? May 14th, 9:30-10:30 (+ Discussion)