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CIDMA CENTRO DE I&D EM MATEMÁTICA E APLICAÇÕES
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Systems and Control Group Seminar

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Room 11.2.6 (Sousa Pinto)

Mathematics Department, University of Aveiro

Mathematical Perspectives on Emotion Recognition in Speech: From MFCC Derivatives to Optimization Methods

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Abstract

Emotion recognition in speech requires both a detailed analysis of acoustic signals and efficient machine learning methods. In this talk, I will present mathematical approaches to feature extraction, focusing on Mel-Frequency Cepstral Coefficients (MFCC) and their temporal derivatives (delta and delta-delta), which capture the dynamic changes of voice related to emotional states. Beyond feature extraction, I will discuss the role of derivatives in model optimization, showing how algorithms such as L-BFGS, which approximates second-order information, and Adam, based on first-order gradients, influence the training process. The seminar will also cover classical machine learning models (SVM, Random Forest) as well as neural networks (CNN, BiLSTM with Attention), with emphasis on interpretability. Finally, practical examples and visualizations – including spectrograms, MFCC with derivatives, and feature heatmaps – will illustrate how mathematical tools and models together enhance the accuracy and understanding of speech emotion recognition.

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