İTÜ FACULTY OF MANAGEMENT DATA SCIENCE AND ANALYTICS DEPARTMENT

DEPARTMENTAL SEMINARS

06 OCT 2025

13:00-14:00

ISB 210

Dr. Muzaffer AYVAZ

TENSOR-BASED MULTIVARIATE POLYNOMIAL OPTIMIZATION FOR SIGNAL PROCESSING, MACHİNE LEARNING AND ARTIFICIAL INTELLIGENCE

SHORT BIO: Muzaffer Ayvaz is a former postdoctoral researcher at KU Leuven, where he was a member of the Group of Science and Technology at the ESAT-STADIUS department. Working with Prof. Lieven De Lathauwer, his research focused on multilinear algebra and its applications, specifically the global optimization of multivariate polynomials using tensor methods. This work has a wide range of applications, including signal processing, machine learning, and artificial intelligence. Prior to his work at KU Leuven, he earned M.Sc. and Ph.D. degrees from the Computational Science and Engineering Department of Informatics Institute at Istanbul Technical University. His Ph.D. thesis explored computational methods of quantum mechanics without wave functions. He also has industrial experience as a software developer and teaching experience in various computer programming and mathematics courses.

ABSTRACT: Many problems in science and engineering can be formulated as multivariate polynomial optimization problems. Matrix and tensor eigenvalue problems, nonlinear dimensionality reduction problems, multivariate polynomial regression problems are only a few examples of this class of problems. Moreover, in many real-life applications, high-degree polynomials are necessary to adequately estimate nonlinearities. However, many methods, such as semidefinite programming-based algorithms, are computationally prohibitive. As a consequence, they cannot be scaled to higher degrees. On the other hand, tensors (multi-indexed arrays) have risen in popularity thanks to their ability to represent higher-order data efficiently. In this study, we present scalable numerical optimization-based algorithms for multivariate polynomial optimization problems using (low-rank) structured tensor formats in the representation of polynomials. We demonstrate our approach for large-scale real-life applications from signal processing, machine learning, and artificial intelligence.