数学与系统科学研究院

计算数学所网络学术报告

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报告题目：

Modeling and Methods of Signal Separations in Spectroscopic Sensing

邀请人：唐贻发 研究员

报告时间：2021 年 8 月 17 日（周二）

上午：9：00

报告工具：ZOOM ID：462 090 3640

会议链接：

https://fiu.zoom.us/j/4620903640

Abstract:

Spectroscopic sensing is an imaging technique widely used for the identification of chemical components or their concentration. A fundamental characteristic of spectroscopic data is that they are usually generated from samples of mixtures, hence nonnegative and correlated. This poses a serious challenge for direct detection and identification of the constituents in the mixtures.

In this talk, we develop a suite of separation algorithms and their mathematical analysis for spectroscopic sensing. The proposed models and methods are based on the intrinsic properties of real-world data such as nonnegativity, sparseness, convex geometry, and statistics. Spectroscopic signals are correlated, so the conventional independent component analysis would fail to decompose the data. Instead, separation methods based on data dependence and nonnegativity are more suitable. Nonnegative matrix factorization is non-convex optimization and often fails to consider the data structure. Besides, little has been studied for its uniqueness. We address these issues by imposing constraints (underlying data structures) to guide solutions towards the desired ones, and by studying identifiability conditions to warrant uniqueness. Real-world data are often contaminated by noise and outliers, which calls for robust and reliable separation methods resistant to these effects. Another complication is nonlinear distortions such as shift and scaling, which exist in certain spectroscopic data due to changing environments or aging equipment. Therefore the reference spectra need to be properly registered before fitting to the data. Computational modeling of reference registration for distorted signals will be developed to improve the separation results.

个人简介：

Dr. Yuanchang Sun, an associate professor of mathematics, received his Ph.D. in applied and computational mathematics 2009 from Michigan State University. Before joining FIU, he has been working as an visiting assistant professor at Univ of California Irvine from '09-'12. He has been an Assistant Professor of FIU since August of 2012. Dr. Sun's research areas include 1) signal separations and decompositions, and data analysis; 2) mathematical modeling, analysis, and computations of light-matter interactions on nanometer scales; Over the years, he has made a numer of publications and presentations in these topics, and he has taught a variety of courses including calculus, differential equations, numerical analysis, topics in mathematical modeling, etc. Over the past years, he has received several awards and honors including a collaboration grants for mathematicaian from Simons Fundations from 2016-2021. For the fall of 2018, he is teaching Topics in Mathemtical Modeling and Calculus One. When he is not occupied by research and teaching and help wife taking care of their kids, he usually goes swiming, basketball, or other outdoor activities.

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