SampTA 2019
13th International conference on Sampling Theory and Applications
université de BORDEAUX
July 8-12

Thursday July 11, 8.30-12.10 am

Wegener	8.30-9.30	*Bagging the Peaks: Matrix and Tensor Factorization with Unimodal Constraints* Urbashi Mitra Chair: Massimo Fornasier
	9.30-10.00	*Coffee Break*
		Missing data imputation (invited session) Chair: Laura Balzano & Rod Little
A9 Amphi 1	10.05-10.30	*Comparison of Imputation Methods for Race and Ethnic Information in Administrative Health Data* Ofer Harel, Yishu Xue & Robert Aseltine
	10.30-10.55	*Adaptive sequential regression imputation methods using machine learning techniques* Trivellore E. Raghunathan
	10.55-11.20	*Tractable Learning of Sparsely Used Dictionaries from Incomplete Sample* Thanh Nguyen, Akshay Soni & Chinmay Hegde
	11.20-12.10	*Panel discussion*

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		Fourier analysis and sampling Chair: Fourier analysis and sampling
A9 Amphi 2	10.05-10.30	*Sampling over spiraling curves* Philippe Jaming, Felipe Negreira & José Luis Romero
	10.30-10.55	*Time encoding and perfect recovery of non-bandlimited signals with an integrate-and-fire system* Roxana Alexandru & Pier Luigi Dragotti
	10.55-11.20	*Optimal Spline Generators for Derivative Sampling* Shayan Aziznejad, Alireza Naderi & Michael Unser
	11.20-11.45	*On cosine operator function framework of windowed Shannon sampling operators* Andi Kivinukk, Olga Graf & Anna Saksa
	11.20-12.10	*On Identifiability in Unlimited Sampling* Ayush Bhandari & Felix Krahmer

Bagging the Peaks: Matrix and Tensor Factorization with Unimodal Constraints

Urbashi Mitra (University of Southern California, USA)

Abstract: We consider matrix and tensor factorization problems where there are both unimodal and rank constraints. Such methods find application in a variety of problems such as target localization, environmental monitoring, epidemic detection, and medical diagnosis. We presume that we have incomplete (sparse) and noisy samples of a particular field or image and that our objects of interest have spatial extent and can be modeled as low rank and unimodal: there is a single strong signal peak and this signal decays as one moves away from the strong signal peak. By exploiting modern signal processing techniques such as matrix completion and active search methods, we develop a high performance, moderate complexity algorithm for peak detection. This method is extended to the case of multiple targets via novel matrix factorization and isotonic projection methods. We further extend the approach to handle multimodal sensor data by exploiting tensor completion methods. Finally, we show how we can exploit our methods to solve a data clustering problem which is motivated by the application of radio map building. Radio signals in urban environments can be described by multiple propagation models. We can transform and compress location-labeled wireless channel measurements into a low-dimensional feature matrix. By analyzing the local peaks of the feature matrix, we can identify the regional propagation laws, which enable the clustering of the data. Theoretical performance bounds derived and properties of key matrices are proven. The methods are compared against the state of the art on both synthetic and real data sets and shown to offer superior performance with moderate complexity.

Missing data imputation (invited session)

Chair: Laura Balzano & Rod Little

10.05-10.30: Comparison of Imputation Methods for Race and Ethnic Information in Administrative Health Data

Ofer Harel, Yishu Xue & Robert Aseltine

Abstract: In the United States of America where there is no national health care, All-Payer Claims Databases provide great resources to investigate and address disparities in access to, utilization, and outcomes of care. Race/ethnicity being missing, however, is a bottleneck on its usage. In most health claim databases Race/ethnicity only observed to $3-5\%$ of the observations, causing a great missing data problem. We try to recover race/ethnicity information for incomplete observations based on studies of the (3%) complete observations. To emulate the data structure, an analysis of birth records from Connecticut is done where the race/ethnicity information is complete, in order to assess competing models performances. While the CT-based full model based on logistic model proposed achieves over 80% prediction accuracy, we are interested in comparing this model performance to more complex machine learning methods and evaluate prediction. An empirical study is presented.

10.30-10.55: Adaptive sequential regression imputation methods using machine learning techniques

Trivellore E. Raghunathan

Abstract: Multiple imputation is used for a variety of problems that can be formulated as missing data problem. Under this approach, the set of missing values are replaced by a several plausible sets of values to created several completed data sets. Each completed data set is analyzed separately and the results are combined. The crux of the problem, of course, is the creation of plausible sets of values. One potential approach is the Sequential Regression Imputation Method (SRIM) (also called Chained Equations) where the predictive distributions of the missing set of values are constructed through a sequence conditional regression models for each variable with missing values and all other variables as predictors. This paper proposes to use a collection of machine learning tools for an adaptive selection of regression models to ensure that the underlying assumptions are satisfied and, finely tuned, if not. A numerical illustration and simulation study evaluate the properties the proposed approach.

Missing data imputation (invited session)

Chair: Laura Balzano & Rod Little

10.55-11.20: Tractable Learning of Sparsely Used Dictionaries from Incomplete Sample

Thanh Nguyen, Akshay Soni & Chinmay Hegde

Abstract: In dictionary learning, we seek a collection of atoms that sparsely represent a given set of training samples. While this problem is well-studied, relatively less is known about the more challenging case where the samples are incomplete, i.e., we only observe a fraction of their coordinates. In this paper, we develop and analyze an algorithm to solve this problem, provided that the dictionary satisfies additional low-dimensional structure.

Fourier analysis and sampling

Chair: Fourier analysis and sampling

10.05-10.30: Sampling over spiraling curves

Philippe Jaming, *Felipe Negreira* & José Luis Romero

Abstract: We present our recent work on sampling along spiral-like curves, and discuss the main techniques. As a first result we give a sharp density condition for sampling on spirals in terms of the separation between consecutive branches. We then further show that, below this rate, the numerical stability related to the reconstruction of compressible signals when sampled along spirals is significantly limited by the amount of undersampling.

10.30-10.55: Time encoding and perfect recovery of non-bandlimited signals with an integrate-and-fire system

Roxana Alexandru & Pier Luigi Dragotti

Abstract: Time encoding represents an alternative method of sampling, based on mapping the amplitude information of a signal into a time sequence. In this paper, we investigate the problem of time encoding based on an integrate-and-fire model, consisting of a feedback loop with an integrator and a threshold comparator. We focus on particular classes of non-bandlimited signals such as streams and bursts of Diracs, and prove we can recover these perfectly from their time information.

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Fourier analysis and sampling

Chair: Fourier analysis and sampling

10.55-11.20: Optimal Spline Generators for Derivative Sampling

Shayan Aziznejad, Alireza Naderi & Michael Unser

Abstract: The goal of derivative sampling is to reconstruct a signal from the samples of the function and of its first-order derivative. In this paper, we consider this problem over a shift-invariant reconstruction subspace generated by two compact-support functions. We assume that the reconstruction subspace reproduces polynomials up to a certain degree. We then derive a lower bound on the sum of supports of its generators. Finally, we illustrate the tightness of our bound with some examples

11.20-11.45: On cosine operator function framework of windowed Shannon sampling operators

Andi Kivinukk, Olga Graf & Anna Saksa

Abstract: The aim of this paper is to consider the cosine-type Shannon sampling operators in the unified cosine operator function framework. In particular, we present the numerical estimates for the operator norms as well as for the order of approximation.

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Fourier analysis and sampling

Chair: Fourier analysis and sampling

11.45-12.10: On Identifiability in Unlimited Sampling

Ayush Bhandari & *Felix Krahmer*

Abstract: In recent work, the authors introduced the Unlimited Sampling framework which establishes that a bandlimited function can be perfectly recovered from a constant-factor oversampling of its modulo samples, hence complementing recent developments in sensor design. This new sensing framework allows to overcome the clipping or saturation problem that is a fundamental limitation common to all formats of conventional digital sensing that rely on Shannon's sampling theorem. In contrast to critical sampling rate of one sample per second, the sampling density criterion prescribed by the Unlimited Sampling Theorem requires a factor of 2 pi e oversampling. In this paper, we prove identifiability conditions linked with the unlimited sensing setup. Our main result establishes that any sampling rate that is faster than critical sampling allows for one-to-one mapping between a finite energy bandlimited function and its modulo samples. This result is corroborated by experiments and opens further interesting questions around the topic as it relaxes the previously held oversampling criterion.