Ecole Doctorale STIC

Sciences & Technologies de l'Information et de la Communication

ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2011

Titre du sujet :	Tensor Signal Processing
Mention de thèse :	ATSI
HDR Directeur de thèse inscrit à l'ED STIC :	Comon Pierre

Co-encadrant de thèse éventuel :

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Laboratoire d'accueil :	I3S

Description du sujet :

Multi-Way factor Analysis (MWA) is attracting a growing interest in many disciplines of engineering. Because of its polynomial nature, MWA is probably the simplest extension of the well-known (linear) Factor Analysis. However, despite its extremely wide panel of applications, and its apparently simple expression, it surprisingly still lacks theoretical background. The reason is that this identification problem hides unexpectedly large difficulties.
In fact, several tensor problems still remain open for several decades, and the difficulties should not be overlooked. Yet, the lack of identifiability results (existence, uniqueness) prevents the design of efficient numerical algorithms.

The first objective of this thesis is to identify, and possibly address some of these theoretical problems, prove some conjectures, and develop appropriate optimization algorithms. Multilinear models underlying MWA have been shown to be closely related to tensor algebra and multivariate polynomials, so that tools already exist and can be borrowed from Algebraic Geometry, with the

goal of developing theoretical solutions and numerical algorithms.
The second objective is to apply these solutions to practical problems. The application field will be determined among the following possibilities: localization and source extraction in antenna array signal processing, for instance with application in telecommunications or health (e.g. EEG), or the analysis of environmental data (e.g. water resources, microbial ecosystems...).

References:
[1] P. COMON, "Tensors, usefulness and unexpected properties", in IEEE Workshop on Statistical Signal Processing (SSP'09), Cardiff, UK, Aug. 31 - Sep. 3 2009. Keynote address. Download: hal-00417258
[2] P. Comon, X. Luciani, and A. L. F. de Almeida, "Tensor Decompositions, Alternating Least Squares and other Tales", Jour. Chemometrics, 23:393--405, August 2009. PDF preprint. Download: hal-00410057.
[3] L-H. Lim and P. Comon, "Multiarray Signal Processing: Tensor decomposition meets compressed sensing", Compte-Rendus de l'Academie des Sciences, section Mecanique, 338(6):311--320, June 2010. Download: hal-00512271.

URL : http://www.i3s.unice.fr/I3Sen/labos/SIS/RA9

English version:

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