• Monday 8th

Session : CMB (1)

10h30 - 11h00 : D. Marinucci

Title: *The geometry of wavelets excursion sets*

Abstract: *In this talk, we shall be concerned with the geometric properties of sequences of random fields which represent multipole or wavelet/needlet components of spherical data.*
In particular, we shall study their excursion sets and exploit the Gaussian Kinematic Formula (see Adler and Taylor (2007,2011)) to evaluate the expected values of Lipschitz-Killing curvatures (Minkowski functionals) under standard and nonstandard circumstances, covering for instance nonGaussian transfomations and masked data. We shall also present some explicit formulae for the variances of these statistics, and discuss how they can be exploited to test for asymmetries and local departures from isotropy and Gaussianity in CMB data.

The talk is based on joint works involving Y.Fantayè, F. Hansen, D.Maino, V. Cammarota, S. Vadlamani, I. Wigman.

11h - 11h30 : P. Paykari

Title: *PRISM: Sparse recovery of the primordial spectrum from WMAP9 and Planck datasets*

Abstract: *The primordial power spectrum is an indirect probe of inflation or other structure-formation mechanisms. We introduce a new method, named \textbf{PRISM}, to estimate this spectrum from the empirical cosmic microwave background (CMB) power spectrum. This is a sparsity-based inversion method, which leverages a sparsity prior on features in the primordial spectrum in a wavelet dictionary to regularise the inverse problem. This non-parametric approach is able to reconstruct the global shape as well as localised features of spectrum accurately and proves to be robust for detecting deviations from the currently favoured scale-invariant spectrum. We investigate the strength of this method on a set of WMAP nine-year simulated data for three types of primordial spectra and then process the WMAP nine-year data as well as the Planck PR1 data. We find no significant departures from a near scale-invariant spectrum.*

11h30 - 12h00 : A. Rassat

Title: *Studying Anomalies in the CMB*

Abstract:

12:30 : Lunch at “la maison des séminaires”

Session : Signal processing and applications (1)

14h30 - 15h : J. Rapin

Title: *NMF with sparse regularizations, and application to LC-MS data*

Abstract: *Non-negative matrix factorization (NMF) aims at recovering non-negative signals observed through non-negative mixtures of*

themselves. In this talk, I will present a new sparse NMF algorithm, non-negative Generalized Morphological Component Analysis (nGMCA) which use proximal methods and is able to deal with signals which are both non-negative in the direct domain and sparse in a (potentially redundant) transformed domain. This algorithm can also be adapted in order to deal with data corrupted by a combination of additive and multiplicative noise. I will show how that this ability can be useful in order to deal with liquid chromatography-mass spectrometry (LC-MS), which is a technique aiming at identifying the components of a fluid.

15h - 15h30 : A. Woiselle

Title: *Sparsity for real-time low power video restoration*

Abstract:

15h30 - 16h00 : P. Chainais

Title: *Statistical analysis of a fast superresolution method*

Abstract: *While the registration step is often problematic for super-resolution, many microscopes and telescopes are now equipped with a piezoelectric mechanical system which permits to accurately control their motion (down to nanometers). Therefore one can use such devices to acquire multiple images of the same scene at various controlled positions. Then a fast super-resolution algorithm \cite{eh01} can be used for efficient super-resolution. However the minimal use of r^2 images for a resolution enhancement factor r is generally not sufficient to obtain good results. We propose to take several images at positions randomly distributed close to each reference position. We study the number of images necessary to control the error resulting from the super-resolution algorithm by Elad & Hel-Or 2001 due to the uncertainty*

on positions. The main result is a lower bound on the number of images to respect a given error upper bound with probability higher than a desired confidence level.

19:00 pm : Welcome cocktail at "la maison des séminaires"

• Tuesday 9th

Session : Galaxy survey and weak lensing (1)

9h30 - 10h : F. Abdallah

Title:

Abstract:

10h - 10h30 : F. Lanusse

Title: *Sparsity based weak lensing mass mapping*

Abstract: *Weak lensing data can be used in a number of different ways to probe the universe and constrain cosmology but one particular application is the mapping of the dark matter distribution.*
I will be presenting two novel sparsity based techniques to estimate the dark matter mass map in 2D, combining shear and flexion, and in 3D, combining shear and photometric redshifts.
I will present the application of these techniques to the reconstruction of the HST Stages field.

Break

11h - 11h30 : C. Lin

Title: *A new model to predict weak lensing peak counts*

Abstract: *Peak statistics from weak gravitational lensing (WL) has been shown as a promising tool for cosmology. WL peaks probe directly the high density, non-linear regions of the large scale structure and encompass a wealth of non-Gaussian information on cosmology and structure formation. Unlike tracers such as optical richness, X-ray luminosity or temperature, or SZ Compton-y, WL peaks are free from assumptions like baryon-dark matter correlations, scaling relations, selection functions, etc. Hence, they provide a possibility for forward-fitting analysis for mass function studies.*

Here we propose a new approach to predict WL peak counts, by generating fast simulations of halos without the use of time-consuming N-body simulations. Our method can model peak counts in any cosmology, for which the halo mass function is known. Predictions can be done for peaks obtained from the linearly filtered shear field, but also for non-linear estimators of the reconstructed convergence field.

We validate our method by comparing our fast lensing simulations of halos with N-body runs. We replace identified halos with analytical NFW profiles and randomize their angular positions. The peak abundance remained identical. This demonstrates that, first, diffuse, unbound matter contributes little to lensing signal, and second, halo clustering plays a minor role in peak counting. In addition, we compare our method to the analytical peak abundance prediction model from Fan et al. (2010).

As a sensitivity test, we show that different inputs of $\Omega_ \mathrm{m}$ and σ_8 are discernable by high signal-to-noise peaks ($\gtrsim 4$) in our model. The optimal combinations of parameters sensitive to our approach is under studying.

11h30 - 12h00 : S. Maurogordato

Title:

Abstract:

12:30 : Lunch at “la maison des séminaires”

FREE AFTERNOON !!!!

• Wednesday 10th

Session : Signal processing and applications (2)

10h30 - 11h00 : D. Mary

Title: *Detection of astrophysical sources in hyperspectral data. Applications to the MUSE instrument*

Abstract:

11h - 11h30 : S. Ben Hadj

Title: *Blind source separation based anomaly detection in multi-spectral images*

Abstract:

11h30 - 12h00 : F-X Dupé

Title: *Generalized Sparse-constrained Greedy methods and an application to Poisson denoising*

Abstract: *We present generalizations of Subspace Pursuit, IHT and OMPR, which seek the k-sparse vector that minimizes a generic cost function. We introduce the \emph{Restricted Diagonal Property}, which much like RIP in the classical setting, enables to control the convergence of these greedy methods. To tackle the problem of Poisson denoising, we propose to use GSP together with the Moreau-Yosida approximation of the Poisson likelihood. Experiments were conducted on synthetic, exact sparse and natural images corrupted by Poisson noise. We study the influence of the different parameters and show that our approach performs better than Subspace Pursuit or ℓ_1-relaxed methods and compares favorably to state-of-art methods.*

12:30 : Lunch at “la maison des séminaires”

Session : Galaxy survey and weak lensing (2)

14h30 - 15h : M. Kilbinger

Title: *Higher-order weak gravitational lensing: Skewness, peaks, and intrinsic alignment.*

Abstract: *Weak gravitational lensing beyond the power spectrum contains valuable information about cosmology, and the non-Gaussianity of the large-scale structure. However, to interpret higher-order lensing statistics is challenging. Astrophysical contaminant such as source clustering and galaxy intrinsic alignment (IA) have to be accounted for. Accurate theoretical predictions for the lensing skewness, and the estimation of their covariance, are difficult to obtain, and we have to rely on large N-body simulations. Progress has been made recently for weak-lensing peak counts in divising a probabilistic model based on fast simulations (see Chieh-An Lin's talk).*
I will present cosmological results of higher-order lensing measurements from the CFHTLenS, including the modeling and influence on the results of galaxy clustering and IA. Further, I will outline mitigation techniques of IA contaminations to peak counts.

15h - 15h30 : F. Ngole

Title: *Super-resolution method using sparse regularization for point spread function recovery*

Abstract: *In large scale spatial surveys such as the forthcoming ESA Euclid mission, images may be under-sampled due to the optical sensors sizes. Therefore, one may consider using a super-resolution (SR) method to recover aliased frequencies, prior to further analysis. This is particularly relevant for point source images which provide direct measurements of the instrument point spread function (PSF). We introduce SPRITE - SParse Recovery of InsTrumental rEsponse - which is a SR algorithm using a sparse analysis prior. We show that such a prior*

provides signicant improvements over existing methods, especially on low SNR PSFs.

15h30 - 16h00 : F. Courbin

Title: *Results of the GREAT3 data challenge*

Abstract:

19:30 : Conference dinner at La maison du séminaire

• Thursday 11th

Session : CMB (2)

9h30 - 10h : J. McEwen

Title: *Spin scale-discretized wavelets on the sphere for the analysis of CMB polarization*

Abstract: *We construct a new spin scale-discretized wavelet transform on the sphere that supports a directional and steerable wavelet analysis of spin signals. Scale-discretized wavelets allow in practice the exact synthesis of a signal from its wavelet coefficients. We present new exact and efficient algorithms to compute the spin scale-discretized wavelet transform of band-limited signals on the sphere up to high band-limits.*

Finally, we highlight the application of spin scale-discretized wavelets to analyse polarized cosmic microwave background (CMB) data.

10h - 10h30 : J. Bobin

Title: *Blind separation of partially correlated components, an application to Planck polarized data*

Abstract: *Sparse blind source separation has been well studied in the last 15 years. However, most state-of-the-art methods makes more or less strong assumptions about the sparsity patterns of the sources to be retrieved. However, data from our real world rarely verify these assumptions; most signals exhibit some partial correlations which are not correctly modeled in current methods. We introduce a novel sparse BSS algorithm which is particularly intended to be robust to the partial correlation of sources. The performances of the proposed algorithm will be illustrated with synthetic toy examples as well as a preliminary application to Planck-like polarized CMB data.*

Break

11h - 11h30 : F. Sureau

Title: *Sparse inpainting of polarized CMB data*

Abstract:

11h30 - 12h00 : J-L Starck

Title: *ERC SparseAstro, 5 years later*

12:30 : Lunch at “la maison des séminaires”

End of the workshop