

Multi-componets Data, Signal and Image Processing for Biological and Medical Applications

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Summary 1: Data, Signal, Image

- ▶ Data, Signal, Image
 - ▶ Data: Unstructured
 - ▶ Signal: Structured in time
 - ▶ Image: Structured in space
 - ▶ Extensions: 1D, 2D, 3D, Space-Time, Space-Frequency,
- ▶ Different representations
 - ▶ Data: points in an abstract space, manifold
 - ▶ Signal: time and frequency
 - ▶ Image: space and spatial frequency
 - ▶ Extensions: 1D, 2D, 3D, Space-Time, Space-Frequency,

Summary 2: Data, unstructured

- ▶ One variable case
 - ▶ Histogram and Probability distribution
 - ▶ Parametric and Non parametric
 - ▶ Parametric models:
 - ▶ Method of moments
 - ▶ Maximum Likelihood
 - ▶ Bayesian estimation
- ▶ Muti variable case
 - ▶ Joint Histogram and Joint Probability distribution
 - ▶ Correlation and Independence
 - ▶ Conditional and Marginal pdfs
 - ▶ Copula
 - ▶ Related estimation problems

Summary 3: Time series

- ▶ Time serie and Fourier representation
 - ▶ Continuous / Discrete
 - ▶ Correlation, Inter-correlation, Inter-dependance
 - ▶ Stationarity / non-stationarity
 - ▶ Convolution and Deconvolution
- ▶ Filtering and Denoising
- ▶ Modelling and Prediction
- ▶ Parametric and Non parametric models
- ▶ Parametric models:
 - ▶ Least Squares
 - ▶ Maximum Likelihood
 - ▶ Bayesian estimation

Summary 4: Images

- ▶ Continuous / Discrete
- ▶ Gray and Color images
 - ▶ 2D FT and FFT
 - ▶ 2D Correlation and inter-correlation
 - ▶ Stationarity / non-stationarity
 - ▶ 2D Convolution
- ▶ Filtering and Denoising
- ▶ Modelling and Prediction
- ▶ Simple Markovian models
- ▶ Contours and Regions
- ▶ Hierarchical Markov models

Summary 5: Data redundancy, Dimensionality Reduction, ...

- ▶ Redundancy and structure
- ▶ Dimensionality Reduction
- ▶ PCA and ICA
- ▶ PPCA and its extensions
- ▶ Stationarity / non-stationarity
- ▶ Discriminant Analysis (DA)
- ▶ Classification and Clustering
- ▶ Mixture Models
- ▶ Factor Analysis
- ▶ Blind Sources Separation

Summary 6, 7 and 8: Medical and Biological Applications Case studies

- ▶ EEG, ECG, MEG, IRM,
- ▶ Computed Tomography
- ▶ Case studies in Cancer Research