Digital Data Analysis

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Data Quality: The state of completeness, validity, consistency, timeliness and accuracy that makes data appropriate for a specific use.

`http://www.ft.com/cms/s/2/21a6e7d8-b479-11e3-a09a-00144feabdc0.html`

Objectives

The aim of the course is to provide to the student a broad overview of the various methods and techniques of data analysis, with a deeper insight on those used in modern-time astrophysics. In particular, we will study the aspects of digital information access, handling, restoration, manipulation, compression and transformation into data. All these aspects will be also tackled in the laboratory sessions, where the students will have the opportunity to work on actual astrophysics data-sets to implement the algorithm introduced in the lessons.

Obiettivi

Lo scopo del corso è fornire agli studenti una panoramica a largo spettro dei vari metodi e tecniche di analisi dati, con un approfondimento per quelli utilizzati nell'astrofisica moderna. In particolare, si studieranno gli aspetti di accesso, gestione, ricostruzione, manipolazione, compressione e trasformazione dell'informazione digitale in dato. Tutti questi aspetti verranno anche affrontati nelle sessioni di laboratorio, in cui gli studenti avranno modo di lavorare su dataset astrofisici reali per implementare gli algoritmi presentati durante le lezioni.

Program

The Transforms

Signal Processing

Sampling of Signals

The Sampling Theorem
The Convolution
The Correlation
Correlation is not Causation
Decomposition of the Signal on the Sphere

The Fourier Transform

The DFT
The FFT
The Power Spectrum
The Phases
Discretization of the Signal on the Sphere

The Information

Wavelets

PCA and EMD

Data Compression
MP3, JPEG2000, JP3D

The Signal and The Noise

The Noise

Noise sources

Noise types and Spectra

SNR maximization

Noise suppression

Data Restoring

Image reconstruction vs Scanning

Speckle Imaging

Blind Deconvolution

Data Analysis

Patterns in Data

Punctual Operators and Filters

More Transforms

Morphological Operators and Descriptors

In the LAB

Data access

FITS

multiFITS

Datafication examples

H-R diagram

Kepler data and star periods

The Fourier Transform

Fourier Spectrum

Digital Filters

Data Manipulation: shifts, transforms

Data-cubes Analysis

Wavelet Spectra

EMD analysis

Data compression

Image quality estimators

Image information estimators

- 1: Mandal, M. & Asif. A.: *Continuous and Discrete Time Signals and Systems*. Cambridge University Press, 2007, ISBN 0521854555.
- 2: Pang, T.: *An introduction to computational physics*. Cambridge University Press, 2006, ISBN 0521825695.
- 3: Oppenheim, A.V. & Schafer, R.W.: *Discrete Time Signals Processing*. Prentice Hall, 1989, ISBN 0132167719.
- 4: Bocharova, I.: *Compression for Multimedia*. Cambridge University Press, 2010, ISBN 9780521114325.