

Doctoral training module DataFit – Code Amethis : 3M403-B

Traitement de données et modélisation / Data analysis and simulation

Number of hours of doctoral training (volume horaire) : 30

Candidatures accepted by Amethis until 06/09/2023 (provisional date – registrations will be possible when the S3M Doctoral School reopens to update Amethis, but I will also accept candidatures by email) <https://amethis.doctorat-bretagneoire.fr>

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This module – **entirely taught in English** – aims to equip students to analyse, fit, and present typical datasets that would be obtained in physical science and engineering research projects. The course is taught using the data analysis and graphical package Igor Pro that is made available to all students. Both lectures and hands-on tutorials using Igor Pro are given in a classroom of the *Pôle Numérique Rennes Beaulieu* and retransmitted to Brest and potentially any location within the Campus Numérique system (e.g., ENSSAT Lannion). By arrangement you can also use other software such as Python or Matlab.

Course content is as follows

General Introduction: Data fitting and error estimation in the physical sciences.

Part 1 – Error estimation and statistical description of data; Introduction: Uncertainties in measurement (accuracy and precision); Distributions and averages; Central limit theorem; Error analysis – internal and external errors; Simple error estimation – propagation of errors; Rejection of outliers – Chauvenet’s criterion; Weighted means and weighted errors.

Part 2 – Data fitting; Linear Least-squares data fitting: χ^2 minimisation; Straight line fit; Confidence limits; Testing the fit; Student’s *t*-distribution; General linear least squares. **Non-linear least squares data fitting:** Introduction; Examples of non-linear functions common in nature; Exponential decay; Methods of minimising χ^2 ; The Marquardt algorithm. **Other methods of data fitting:** Least absolute deviation; Maximum likelihood method; Robust estimation; Data smoothing

Part 3 – Data analysis: Elements of systems and signals; Fourier analysis and applications; Sampling and Fourier analysis of discrete signals; Convolution, correlation and deconvolution

Part 4 – Advanced topics; Digital filtering; Modulation and phase sensitive detection; (Laplace and z-transforms; System transfer functions; Filter design and implementation)

Validation: by assessed projects based on tutorial sheets.

Location: PNRB Beaulieu Salle TP / connections within C@mpus Numérique from other sites

Dates 2023-24:

10 sessions Fridays 09h00 - 12h00 starting on 08/09/2023 until 24/11/2023 inclusive , but no course on Friday 15/09/2023 or 03/09/2023.

The module is integrated in the UE: Acquisition et traitement de données (niveau avancé) / Data acquisition and processing (advanced level) which is also taken by students following the M2 Physique et Instrumentation at Brest (UBO).