An introduction to numerical approaches to reconstruction in medical imaging

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Timetable: 16 hrs. First lecture on November 7, 2018, 09:00 (dates already fixed, see calendar). Torre Archimede, Room 2BC/30

Course requirements: introductory course(s) on numerical analysis and basic programming skills*. Familiarity with probability and statistics can be helpful but is not required.

Examination and grading: based on project assignment.

SSD: MAT/08 Numerical Analysis

Aim: The course intends to introduce reconstruction problems for tomographic and biomagnetic data. In medical imaging these problems need to be solved in order to transform raw data into human-readable images. From a mathematical view point, these problems are formulated in the inverse problems framework and this course aims to present computational approaches for their solution and the related numerical issues.

Course contents:
The course aims at introducing the student to:

- Part I: Electroencephalography (EEG) and Magnetoencephalography (MEG) (overview); Regularization methods
- Part II: Lab experience on MEG data.
- Part III: X-ray Computed Tomography (CT), Positron Emission Tomography (PET) (overview) and Single Photon Emission Tomography (SPECT) (overview). Radon transform, formulas for the inversion of the Radon transform (as back projection and filtered back projection). Iterative methods.
- Part IV: Lab experience on Radon transform.

References:

- T. G. Feeman, The Mathematics of Medical Imaging, Springer (2010).
- J. Kaipio, E. Somersalo, Statistical and Computational Inverse Problems, Springer-Verlag (2004).

*E.g. https://www.codecademy.com/learn/learn-python, https://matlabacademy.mathworks.com/