FACHRICHTUNG 6.1
MATHEMATIK
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UNIVERSITÄT DES SAARLANDES

Inverse problems for Imaging modalities

Summersemester 2016

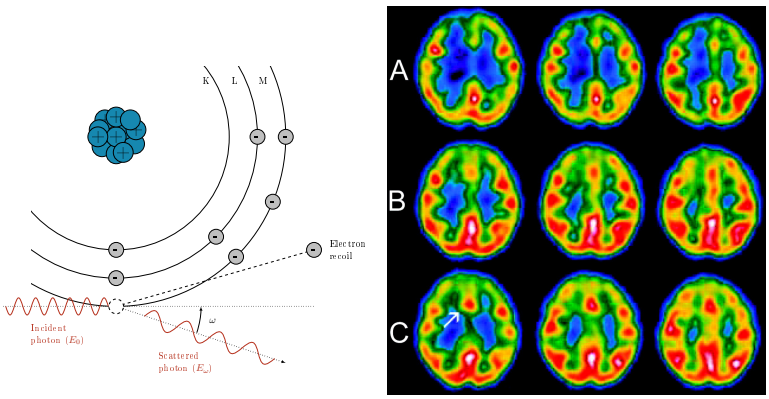
The concept of non-invasive imaging techniques is based on the interaction between an object (e.g. human being, materials) and a physical or chemical vector (e.g. electromagnetic wave, ultrasound, magnetic field,) to study the structure or the intern functioning of this object. In most cases, the measurement g can be modeled as

$$g = \mathcal{A}f$$

where $\mathcal{A}$ is the acquisition model (forward operator, matrix) and f describes a characteristic of the investigated medium. Thus, the reconstrution of f from the data g matches with solving the inverse problem associated to $\mathcal{A}$. The acquisition model, as for it, reflects the interactions waves/matter and hence requires their perfect understanding.

The purpose of this course is to provide an overview of the imaging modalities such as CT, SPECT, MRI, Compton scattering tomography, reflective imaging, and of the reconstruction techniques via the study of the associated inverse problems. In each case, the course will be built as follows: from the physical interactions, leading to the measurement, we establish the acquisition model $\mathcal{A}$; we study its properties and provide its inversion or at least an inversion scheme; finally we implement this forward-inverse scheme highlighting the numerical issues.

Basis knowledge in Applied Mathematics, Linear Algebra and Analysis is recommended.



(a) (b)

Figure 1: (a) Geometry of Compton scattering: the incident photon energy E_0 yields a part of its energy to an electron and is scattered with an angle ω. (b) Detection of Alzheimer's disease in SPECT imaging.

Date: Friday, 10-12 hrs. The classroom will be announced.
Exercices: Thursday, 10-12 hrs (every two weeks).

More information on the webpage: www.num.uni-sb.de/iam