Bachelor or Master Thesis

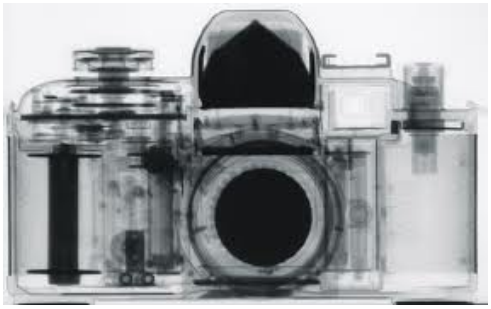
Image processing techniques applied to reconstruction algorithms for neutron imaging

Course of study:	Computer Science or Applied Mathematics
Kind of thesis:	Survey, Programming, and Simulation
Programming language:	Any (Fortran, C++, etc.)
Start:	Immediately

Problem

Similar to x-rays, neutrons can be used for imaging. The advantage of fast neutrons with respect to x-rays is their deeper penetration depth into dense materials. A compact neutron radiography system is currently under development, which can be used in addition to existing imaging techniques. The main aplication is the characterization of radioactive waste, but the technology can be used for electronics recycling, quality control in manufacturing, engine design, among others.

Our global objective is to design image reconstruction algorithms based on the radiative transfer equation, with the main focus being the correction of diverging (cone) beams arising from the point source. This project deals with a specific portion of this problem: categorizing current image processing techniques and evaluating their effectiveness in this particular application.



Preliminary work

The reconstruction algorithm of the divergent beam is already implemented. Its output is a bidimensional radiography image of the sample. This preliminary reconstructed image presents blur and noise aspects, which need to be managed.

Task

In the project, a survey of image processing methods that deal with blur and noise shall be conducted. Such techniques include (but are not limited to): filters (e.g. Wiener), wavelets, blind deconvolution, variational PDE models (e.g. Mumford-Shah, Perona-Malik), and statistical models (e.g. penalized-likelihood estimation). Then, the algorithms must be developed and applied in the preliminary reconstructed images, and the effectiveness of each method investigated. A final report on the advantages and disadvantages of each surveyed method shall be generated.

Supervision

This project is conducted by the *Computational Nuclear Engineering* (MathCCES) research group headed by Prof. Dr. Martin Frank. The project will be supervised by

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