Laboratoire d'intégration des systèmes et des technologies
Département Imagerie Simulation et Contrôles

MASTER

Physical projector in computed tomography

Description

Advanced reconstruction methods in computed tomography [CT] in medical imaging, non-destructive testing, material science… are based on a discretization of the linear problem such y=Ax+n where x is the image described as pixels or voxels, which has to be recovered, y is the set of measurements and the A matrix is the projector. Each a_{ij} value denotes the contribution of pixel j to measurement i. Existing simpler models consider for instance a_{ij} as the intersection length between ray beam i and pixel j. However, more advanced models have to be developed in order to afford realistic X-ray source properties (surfacic emission), detector response (finite spatial resolution) and physical interaction in the sample or the human body.

The objective of this work is to propose a new approach describing realistic projector in CT. A generic parametric model will be proposed, for which Monte Carlo simulations (optimal estimation of X-ray image) will be used to estimate model's parameters, depending on material characteristics (elements, density). As a second step of this work, considering iterative reconstruction methods, a dynamic projector will be developed to match the last estimated image properties in the iterative process.

Due to the heaviness of calculation, proof of concept will be performed in 2D, using the Civa NDT platform as X-ray image modeling. Extension to 3D will require sparsifying method to ensure the feasibility of the approach. This part will be addressed during the PhD following this master work.

Key words: tomography, imaging, physics

Computer language: C++ or Matlab

Main skills: computer science, numerical methods, modeling, optimisation

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