Image reconstruction for x-ray tomography: a survey of algebraic methods

Eric Badel

School of Mathematical Sciences
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Image reconstruction for x-ray micro tomography: a survey of algebraic methods

Speaker: Dr Eric Badel
Date: Wednesday 12 December
Time: 10:00 AM
Location: O603, Gardens Point Campus, Queensland University of Technology

Following the seminar, light refreshments will be served in the School of Mathematical Sciences Staff Room (O614).

Abstract: In material sciences, the need for morphological information for material characterisation is increasing. Many properties (mechanical, thermal, shrinkage,...) are strongly linked to the actual structure of the material and the study of these relationships is a very large and exciting new research field. The use of x-ray imaging facilities is interesting because they allow a non-destructive observation at a high spatial resolution (around one micrometre). Moreover, we can now access the 3D structure. After the acquisition of the data, the "reconstruction" step allows a 2D image to be recovered using several 1D profiles or, using a 2D detector; a 3D volume can be recovered using 2D images. Currently, Fourier methods are used for this recovery process, especially in the medical field, to obtain sharp images for the eye. In x-ray microtomography one of the limitations of the reconstruction process is the limitation of the x-ray cone angle during the data acquisition. Furthermore, because the modelling possibilities of the tomographic process are increasing and computing facilities are more powerful, there is now a resurgence of algebraic methods for solving the enormous least squares problems (of the order of several million equations) associated with the image reconstruction process. This talk is focused on 2D image reconstruction. We first introduce a fast x-ray tracing technique that allows the components of the matrix to be rapidly computed so that storage of the matrix can be avoided. Then we discuss some of the classical row projection iterative methods (ART, SART) for image reconstruction. Finally, we propose an alternative solution strategy based on a "live" bi-diagonalisation of the system matrix. The problem of the regularisation parameter is also discussed. Some of preliminary results are presented to obtain an accurate and fast image, since a lot of work is to be done.

Biography: Dr Eric Badel received his B.S in Mechanics from the University of Lyon (France) in 1996. He was awarded his PhD in Wood Sciences in 1999 in Nancy. He moved to Lyon to work on x-ray tomography, before returning to Nancy, where he holds his current position as scientist in the National Institute for Agronomy (INRA). Dr Badel's research interests were first focused on wood properties (mechanics, hygroscopic shrinkage) and their relationship with the microscopic structure of the material. He developed several experimental devices in order to measure the parameters needed: tensile test under microscope, shrinkage under x-ray imaging, digital 2D x-ray imaging and recently a 3D x-ray microtomograph dedicated to the soft materials and especially to the vegetable materials. His field is now larger since these tools are applied to other natural fibre materials like tissue or fibreboards.