1.9.20. A TRANSLATION-BASED DATA ACQUISITION SCHEME FOR INDUSTRIAL COMPUTED TOMOGRAPHY

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Today, most computed tomography (CT) systems use a fan-beam-type geometry and acquire projection data from several hundred to thousands of directions by employing multirow (in 2-D) or flat-panel detectors (cone-beam for 3-D imaging). It is important to notice the following fact: although modern CT systems resemble a powerful tool in the field of industrial non-destructive testing (NDT) as well as for medical diagnostics, they all rely on a rotational movement. The most widely utilized reconstruction algorithms, as for instance the well-known Feldkamp method, are based on filtered back projection (FBP). These algorithms afford a series of projection images out of an angular range of at least 180°.

Nevertheless, in reality there are many objects which should be inspected by X-ray CT but do not allow for a rotational movement. These are non-portable or very heavy objects which cannot be accessed from all directions. For instance, such an object could be a bundle of tubes positioned in the corner of a building or a cable channel embedded in a wall. With conventional data acquisition methods requiring a rotational movement, it has been almost impossible to measure 3-D images of these kind of objects using CT.

In this presentation, we propose a new method for CT data acquisition, which requires almost no rotational movement of the system, respectively the object. The new method is derived from the observation that both the direction (the angle) and the shortest of each ray with respect to the object change, when the distance between the X-ray source and the detector changes. Or, in other words: the rotational movement is substituted by one or more linear movements of the X-ray source towards the object to be inspected.

Our strategy to make use of the data acquired by translational movement is twofold: on the one side, the measurements should be extended such, that a larger fraction of the full 180° angular range is filled. On the other side, the mathematically exact reconstruction given by the filtered back projection can be modified to calculate cross-sectional images without providing the complete data theoretically needed. Alternatively, algebraic reconstruction techniques can be applied, which are intrinsically adequate for reconstructing incomplete data, but – as a drawback – are much slower than analytical methods due to their iterative nature.

We will present a theoretical evaluation of the translational acquisition scheme. The issues of image reconstruction will be discussed and results from simulations with varying measurement parameters will be shown.