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Deterministic Simulation of Arbitrary CT Measurements with Experimental Verification

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Thomas Riedel
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Dekan:	Prof. Dr. M. Röllinghoff
Referent:	Prof. Dr. W. Kalender *Institut für Medizinische Physik, FAU Erlangen-Nürnberg*
1. Korreferent:	Prof. Dr. G. Anton *Lehrstuhl für Experimentalphysik, FAU Erlangen-Nürnberg*
2. Korreferent:	PD Dr. M. Kachelrieß *Institut für Medizinische Physik, FAU Erlangen-Nürnberg*

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Preface by the Editor

Simulations are a powerful and indispensable tool in the design of systems. This statement certainly holds true for the evaluation of concepts for modern CT scanners. New detector designs, arbitrary focus trajectories and new reconstruction algorithms can be tested and evaluated without the need to provide the physical equivalent. Also, for already existing designs it may be much easier to vary given parameters in a virtual experiment conducted by simulation than it would be in reality.

The dissertation of Thomas Riedel presented in this volume is dedicated to the development of flexible simulation tools for fast deterministic calculation of x-ray attenuation for arbitrary mathematically defined objects. The implemented modular concept makes the tool versatile and easy to use for numerous application fields.

As application examples the simulation was used in two studies. First the optimum scan voltage for the detection of high contrast details with respect to the patient size was investigated. Second the performance of a flat-panel detector for CT imaging was analyzed. This topic is of major interest driven by the aim to increase the z-coverage in CT scanning within a single rotation and by the fact that flat-panel detectors start to replace the conventional image intensifiers in x-ray angiography. The simulations proved to be valuable assistance in verifying measured results.

The simulation tools described in this dissertation are meanwhile in wide use at the IMP, with libraries of objects, spectra, detector materials etc. being added continuously and with Monte Carlo methods added to allow for scatter simulations. They provide a solid basis for innovative work in all fields of X-ray imaging.

Erlangen, December 2004
Willi A. Kalender, Ph.D.
Editor

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