Metal Artifacts in Computed Tomography
- impact of reduction methods on image quality and radiotherapy treatment planning

av

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Akademisk avhandling

Avhandling för filosofie doktorsexamen i Medicinsk vetenskap, som kommer att försvaras offentligt fredagen den 9 mars 2018 kl. 09:30, Hörsal C3 vid Campus USÖ

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Abstract


Degradation of image quality by metal artifacts is a common problem in computed tomography (CT) imaging, which can limit the diagnostic value of a CT examination and also introduce inaccuracies in radiotherapy (RT) treatment planning. In recent years, commercial metal artifact reduction (MAR) methods have been launched by several CT vendors. The overall aim of this thesis was to evaluate MAR methods in diagnostic imaging and RT treatment planning.

Evaluations of hip prosthesis phantom CT images showed that MAR algorithms in general improved image quality, based on both visual grading analysis and quantitative measures, while the application of virtual monoenergetic reconstructions insufficiently reduced metal artifacts. In some cases additional artifacts were introduced by the MAR algorithms. MAR algorithms were also evaluated in hip prosthesis phantom CT imaging used for proton therapy treatment planning, where improvements in dose calculation accuracy were observed.

Studies of Head & Neck (H&N) implant CT images in RT treatment planning were also performed. By visual grading of anatomy visualization with respect to target delineation in dental implant patient images, MAR algorithms were shown to significantly improve image quality. However, only minor effects of H&N implant artifacts on proton dose distributions were seen. The impact might be greater for more severe artifacts than those studied here, and thus further investigations of such cases are needed.

In conclusion, MAR algorithms have been shown to enhance image quality for diagnostic applications and to improve anatomy visualization in RT treatment planning. The MAR algorithms led to increased proton dose calculation accuracy in some cases, while in other situations only minor changes were seen.

Keywords: computed tomography, metal artifacts, image quality, visual grading analysis, radiotherapy, proton therapy, hip prosthesis, dental implants

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