Public Abstract

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Title:Task-Based Image Quality Assessment in Radiation Therapy

Medical imaging is an integral part of radiation therapy. Since these images are used directly to treat patients, image quality assessment (IQA) is important for improving patient treatments. Current IQA methods for radiation therapy do not directly consider the task of treating the patient, but are instead based on the physical properties of the images. Many studies have been dedicated to task-based IQA, which utilize either human or computerized-model observers to assess images based on the task they will be used for. However, this methodology is almost exclusively applied to diagnostic imaging, that is, the task of determining whether or not a patient has a particular disease. The purpose of this dissertation is therefore to provide and demonstrate a robust, fully computer-simulated model observer. This observer utilizes images of known objects to simulate end-to-end radiation therapy treatments, and subsequently evaluates treatments in terms of patient outcome. Thus image quality is linked directly to patient treatment efficacy. As a necessary component of the model observer, a methodology was also developed to generate statistical ensembles of objects, with subsequent CT images being generated from these objects. Using this newly proposed model observer, CT images were assessed and optimized for the task of radiation therapy, and the results were demonstrated as an improvement to other IQA methods which do not consider the specific task of radiation therapy. The model observer was also insensitive to the sources of randomness and bias analyzed in this study. This model observer therefore enables objective, task-based IQA with radiation therapy treatment efficacy as the goal.