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Improving MVCT Image Quality for Quantitative Analysis of Inter-fractional Organ Motion in Prostate Cancer Radiotherapy

Image-guided radiation therapy (IGRT) is important for minimizing daily uncertainties in patient setup when delivering radiation doses to the target volume and adjacent organs at risk (OAR). In intensity-modulated radiation therapy (IMRT), the analysis of megavoltage computed tomography (MVCT) allows for the evaluation of inter-fractional motion, which refers to the movement and changes of organs between radiation treatment sessions. However, poor MVCT image quality can make it difficult to delineate organs and cause inter-observer variability, resulting in inaccurate tracking of changes over time.

This study proposes a tracking and observation framework to quantitatively analyze inter-fractional organ movements in prostate cancer patients using a deep learning-based MVCT image quality improvement method. In this study, we collected datasets of planning kVCT and MVCT images from prostate cancer patients who underwent helical tomotherapy. The proposed technique aims to improve the quality of MVCT images by reducing noise and enhancing contrast using a generative adversarial network. Then, the contours of the major organs considered for prostate cancer treatment, including the bladder, prostate, and rectal balloon, are delineated on daily MVCT images. Using this framework, it is possible to quantitatively evaluate the changes in prostate position according to the changes in rectal balloon position and bladder volume, thereby increasing the accuracy of treatment planning and the efficiency of radiation dose delivery. Ultimately, this framework can enhance the tracking and observation of treatment effects and side effects.

Submission declaration

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