Advanced assistive technology for predicting organ deformation during radiotherapy using image information

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Credit: AI-generated image (disclaimer)

Radiation therapy, employed for treating cancer and other ailments, is distinctive for its minimally invasive nature, facilitating outpatient treatment and a fast return to society. However, a notable challenge arises due to the potential impact of radiation on the adjacent healthy

organs, especially while applying high radiation doses to diseased tissues that are in motion. Regular movements such as breathing can be easily predicted; however, irregular movements initiated by contact with the surrounding organs are difficult to predict.

In this study, published in *IEEE Transactions on Radiation and Plasma Medical Sciences*, a novel technique was devised to predict the 3D motion of each organ based on its position with respect to the surrounding organs. This was achieved by acquiring cross-sectional (2D) images from three different orientations of the affected area in real time during radiation therapy. Additionally, a cross-section selection method was formulated to choose the most accurate cross-sectional image for analysis.

To validate this technique, the researchers assessed the position of the pancreas using publicly available MRI data of 20 cases. The results showed that the pancreas could be located with an error of 5.11 mm when only one directional cross-sectional information was utilized, which markedly reduced to an error of 2.13 mm when all three directions were employed. Additionally, in some instances, the accuracy of the results matched with the ideal scenario wherein the three-dimensional information had been obtained in advance.

The findings of this research hold promising implications for practical applications, potentially paving the way for protocols that minimize radiation exposure to surrounding healthy organs, thereby promoting safer radiation therapy.

More information: Yuki Hara et al, 2D Slice-driven Physics-based 3D Motion Estimation Framework for Pancreatic Radiotherapy, *IEEE Transactions on Radiation and Plasma Medical Sciences* (2023). DOI: 10.1109/TRPMS.2023.3313132

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