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Tracking Tumors for Real-Time Radiation Therapy by Automatic Segmentation

Published date: March 14, 2017

Technology description

External beam radiation therapy degrades the rapidly dividing cells of a tumor by directing high-energy radiation into the target of interest to eradicate it. The efficacy of the treatment is strongly impacted by dosage, which is constrained by the need to spare surrounding tissue and organs. Directing beams to intersect across a tumor, while reducing the dose to areas outside the intersection, can reduce damage to healthy tissue.

Imaging obtained by CT scan or MRI prior to therapy provides a computerized treatment plan designed to 'segment' tissue types, defining volumes of healthy versus afflicted tissue and assigning to each a minimum or maximum dose. But current automated segmentation is inaccurate and laborious when performed manually, requiring a health worker to draw boundary lines on the multiple data slices composing an image. Further confounding ideal treatment is the tendency of tumors to shift and change size during and between sessions—in response to breathing, regression or even bladder filling.

The latest generation of imaging equipment is capable of snapshotting a patient every quarter of a second. To exploit this fully, an automated and equally rapid method to deliver radiation into a tumor despite its deviations is called for. UW–Madison researchers have developed an extremely fast algorithm-based segmentation technique to guide radiation at a rate commensurate with real-time tissue imaging.

Novel Morphological Processing and Successive Localization (MPSL) can be applied to auto-contour the volume, shape and position of a target. The method utilizes predetermined knowledge of the general location and size range of the tumor and based on similarities within value and positioning data, isolates healthy and diseased regions for radiation. More efficient than manual segmentation and more accurate than existing algorithms, the method enables flexible, medical image-guided radiotherapy.
The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method that reduces clinician labor and error by automatically defining volumes of healthy and malignant tissue, and guiding therapy despite changes in tumor location or form.

Additional Information

Tewatia D.K., Tolakanahalli R.P., Paliwal B.R. and Tomé W.A. 2011. Time Series Analyses of Breathing Patterns of Lung Cancer Patients Using Nonlinear Dynamical System Theory. Phys. Med. Biol. 56, 2161-2181.

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Application area

Adaptive treatment planning
Image-guided radiotherapy in real time
Surgery and chemotherapy

Advantages

Efficient automated tissue segmentation
No manual contouring
Applied to quantify changes in tumor volume, shape and position

Institution

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