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INTERACTIVE GEODESIC SEGMENTATION OF N-DIMENSIONAL MEDICAL IMAGES ON THE GRAPHICS PROCESSOR

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PURPOSE

This paper presents a new, parallel segmentation algorithm which enables radiologists to separate a region of interest from 2D or 3D images accurately and efficiently. This, in turn, enables fast and accurate area/volume measurements as well as the extraction of statistics for the selected region.

Our general purpose algorithm can be applied to any visible structure (e.g. a tumour or an anatomical structure) and it is driven by minimal and intuitive user interaction.

METHOD AND MATERIALS

Key to the method is a filtering operation which results from mixing four geodesic distance maps computed on the input image/volume. Such operation ensures desirable properties such as smooth segmentations which follow strong image gradients.

Our algorithm may be thought of as a generalization of level sets and region growing, and can deal with general topology of the selected region while being driven by simple and intuitive user interaction.
Unlike previous techniques, the parallel nature of our algorithm allows its implementation on multi-core CPUs and even on the GPU with high computational efficiency.

Our technique is applied to a variety of image modalities (e.g. CT, MR) and can also optimally use information from multi-modal images (e.g. PET/CT). For instance, the gradient signal used to compute geodesic distances can come from T1 or T2 weighted MR or from a combination of both.

RESULTS

When compared to state of the art methods such as Random Walker and Graph Cut, our technique has shown similar levels of accuracy with much greater computational efficiency. Our parallel CPU implementation yields about 60 times greater speed while our GPU implementation two orders of magnitude faster execution times than Graph Cut.

The algorithm has been implemented within an easy-to-use interface which has been delivered to a number of radiologists for testing. They have shown great interest in the tool

because of the increased accuracy of extracted measurements and ease of use.

CONCLUSION

This paper has presented a new technique for the efficient, interactive segmentation of medical images and volumes.

Thanks to its parallel nature our algorithm is very responsive while negating the need for resolution down-sampling and thus allowing the use of all available image data.

CLINICAL RELEVANCE/APPLICATION

Our algorithm helps radiologists and clinicians to extract clinical measurements from images and 3D volumes as efficiently and accurately as possible.

FIGURE (OPTIONAL)

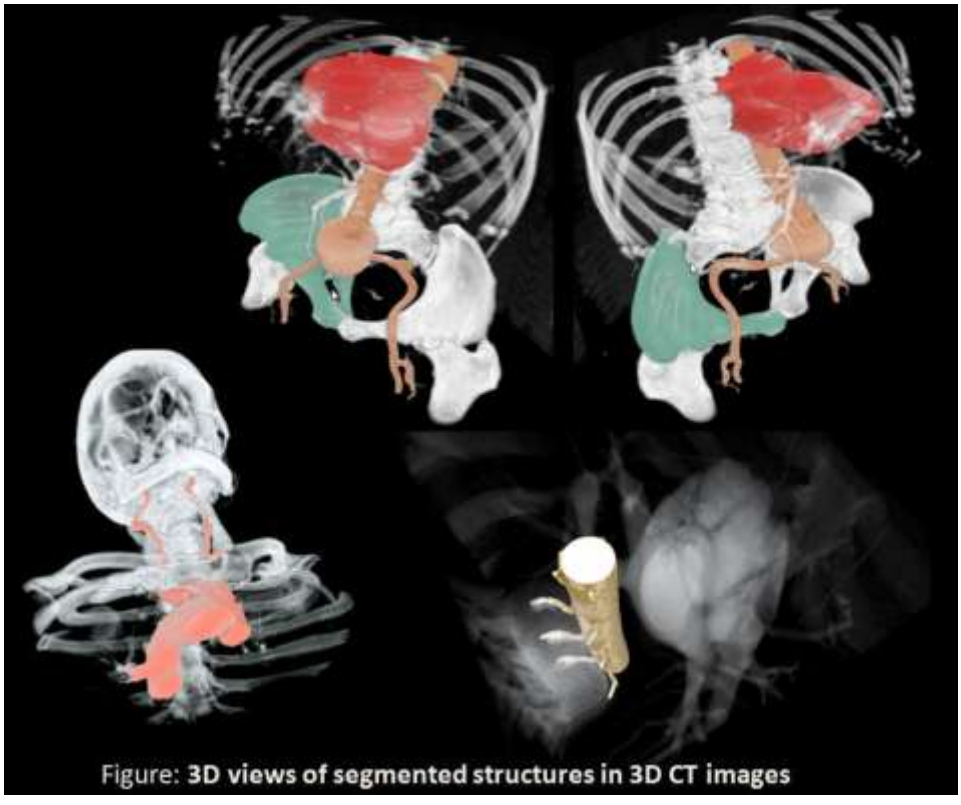

Figure: **3D views of segmented structures in 3D CT images**