Topology Constraint Graph-based Model for Non-small-cell Lung Tumor Segmentation

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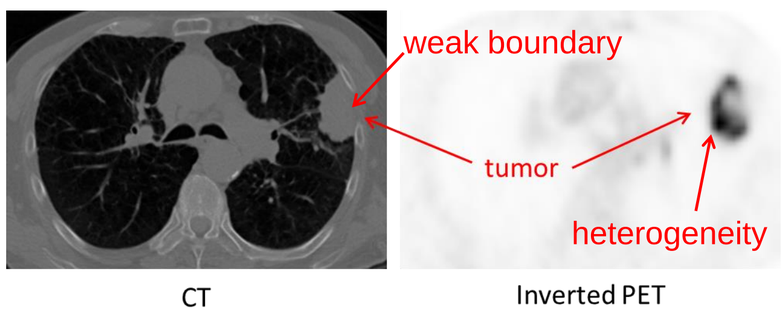
Introduction

Background

- Dearly detection and treatment of non-small cell lung cancer (NSCLC) are important to increase the 5-year survival rate [1];

Challenges

- Indiscernible boundary on computer tomography (CT) images when tumor abuts tissues with similar intensities.
- Heterogeneous tumoral 18F-fluero-deoxy-glucose (FDG) uptake on positron emission tomography (PET).



Aims

- To improve the boundary definition of heterogeneous tumor from thorax PET volumes.
- To represent the topology of tumor on PET by designing a region of interest (ROI) topology skeleton tree.

[1] Cancer Council Australia, http://www.cancer.org.au/about-cancer/what-is-cancer/facts-and-figures.html, 2014.

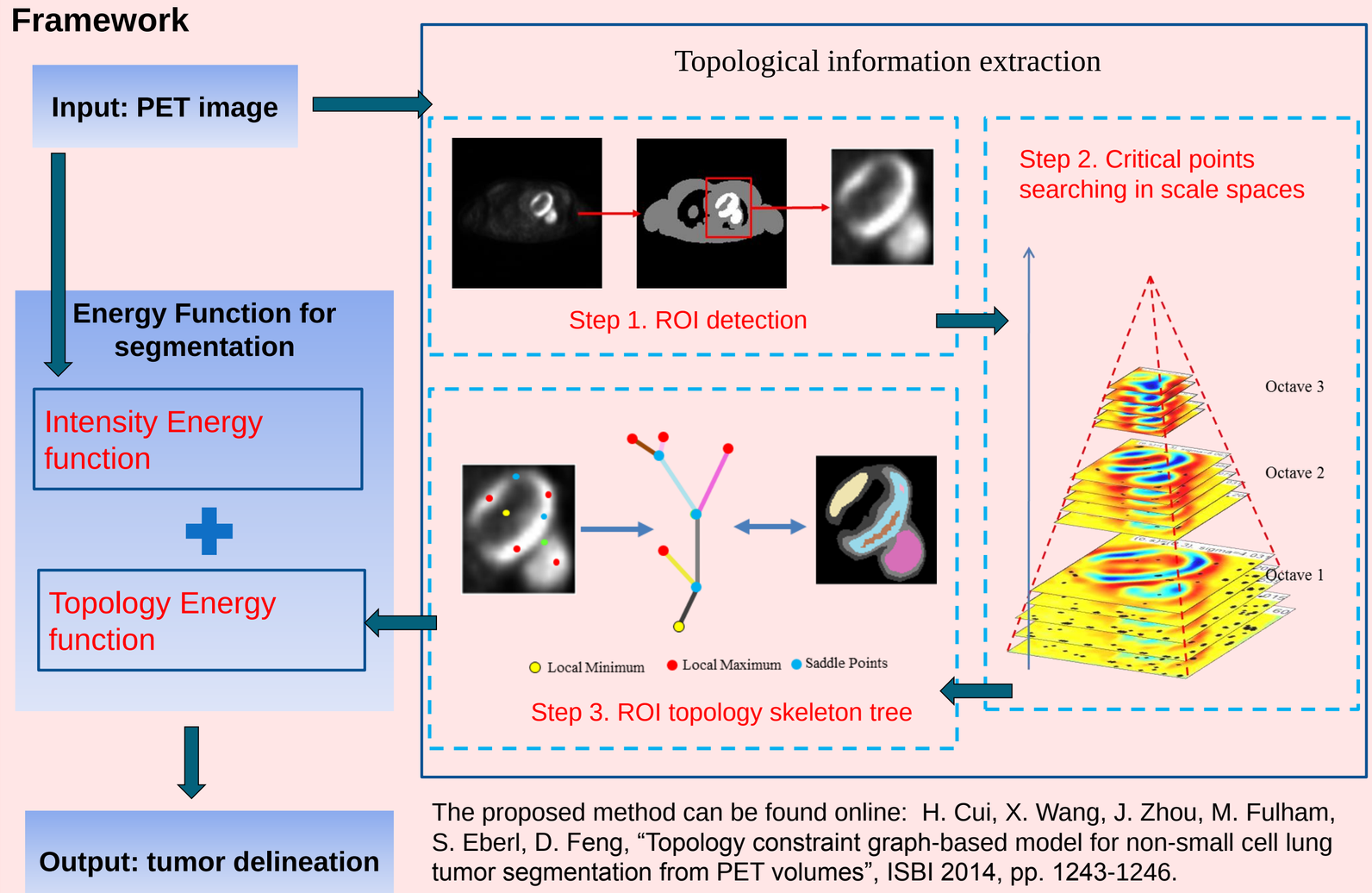
Methods

Motivations

(1) Topological relationship of the image regions provides useful inclusion and connection information for segmentation

(2) An energy function consists of intensity and topology terms would improve the segmentation performance.

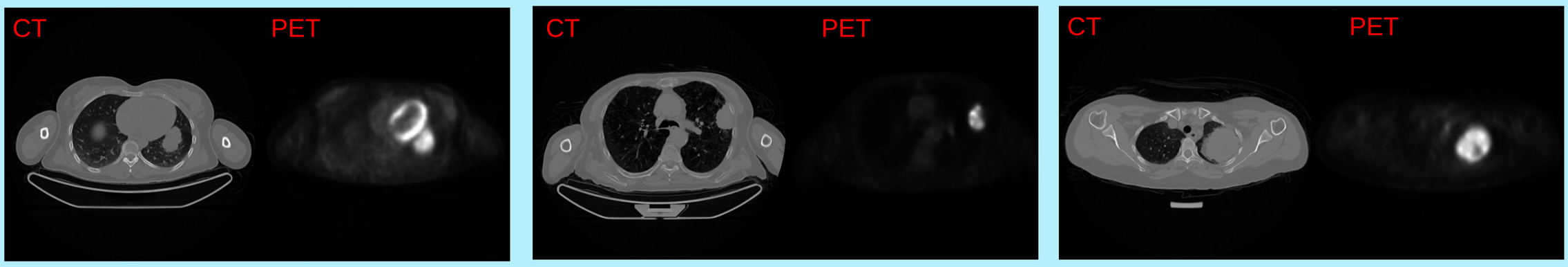
Framework



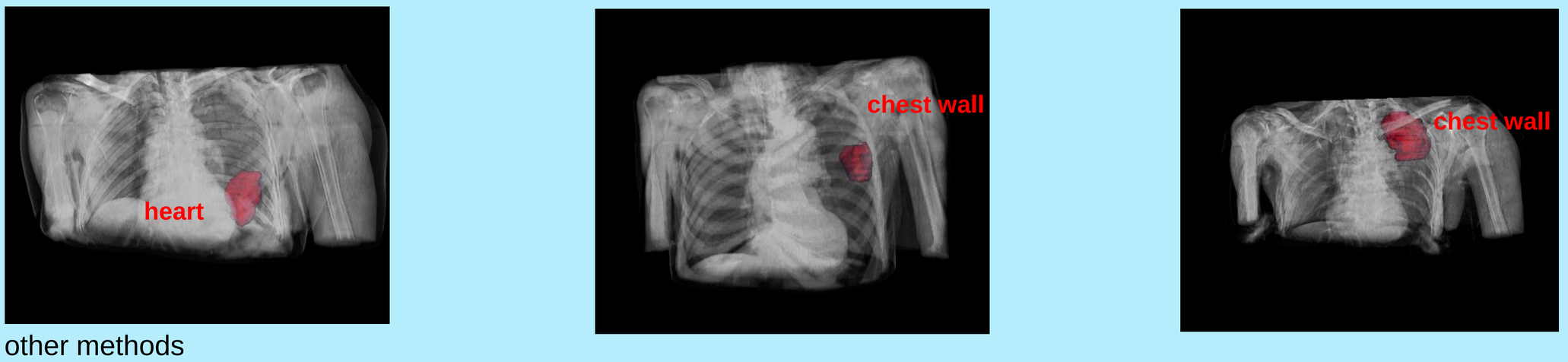
The proposed method can be found online: H. Cui, X. Wang, J. Zhou, M. Fulham, S. Eberl, D. Feng, "Topology constraint graph-based model for non-small cell lung tumor segmentation from PET volumes", ISBI 2014, pp. 1243-1246.

Results

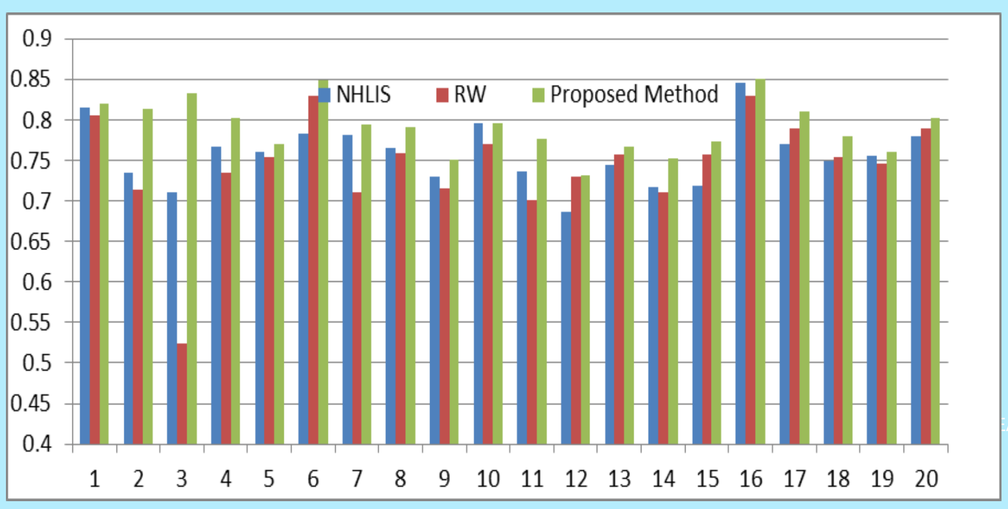
Input



3D visualization of our results



comparison with other methods



[2] T. H. Kim, et al., "Nonparametric high-order learning for interactive segmentation," in ICCVPR, pp. 3201-3208, 2010. [3] L. Grady, "Random walks for image segmentation," TPAMI, vol. 28, pp. 1768-1783, 2006.

Conclusion

- The proposed method outperformed the comparison methods: the conventional RW method and NHLIS which incorporated regional information but without topology connection.
- Overall accuracy:
  NHLIS: 0.757; RW: 0.744; Proposed method: 0.791

Datasets

- 20 studies from NHCLC patients from RPA hospital.
- Tumors are with inhomogeneous FDG uptake, or abutted or extended into chest wall, mediastinum or the diaphragm.