Automatic Vessel Segmentation for Angiography and CT Registration

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Outline

1. Introduction
2. Methodology
3. Results
4. Conclusion
5. Future work

Introduction

- Angiography + Computed Tomography

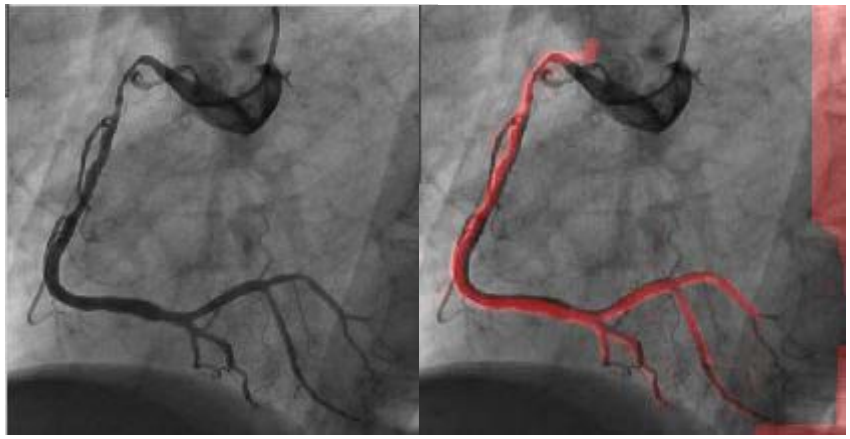


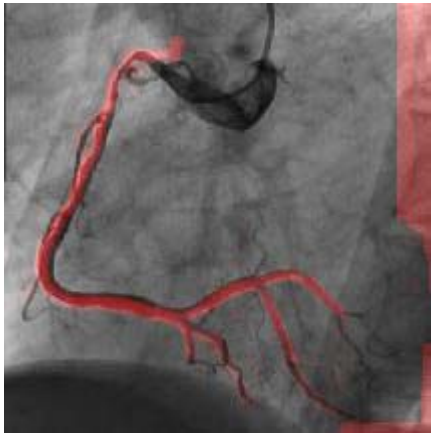
Image (2D) Registration Volume (3D) → Projection

- Hard task, why don't make it easier?

Introduction

- Angiography → Segmentation

Segmentation (2D)



Registration

Volume (3D) → Projection

- Segmentation eliminates noise
  - Better registration?

Methodology

- Graph Cuts (Energy minimization)

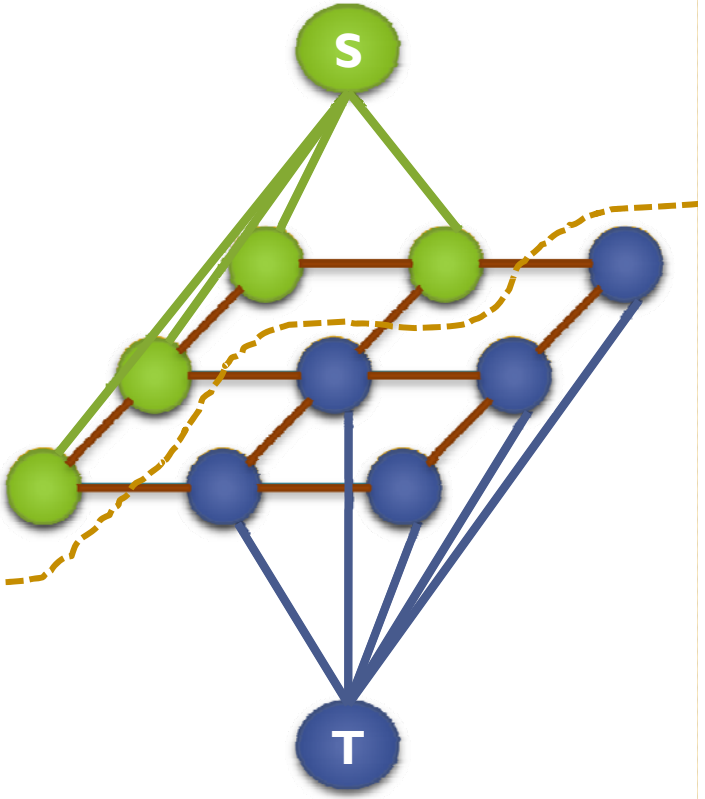
1. Energy function

$$\mathbf{E}(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) = U(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) + V(\underline{\alpha}, \mathbf{z})$$

Unary potential

Pairwise potential

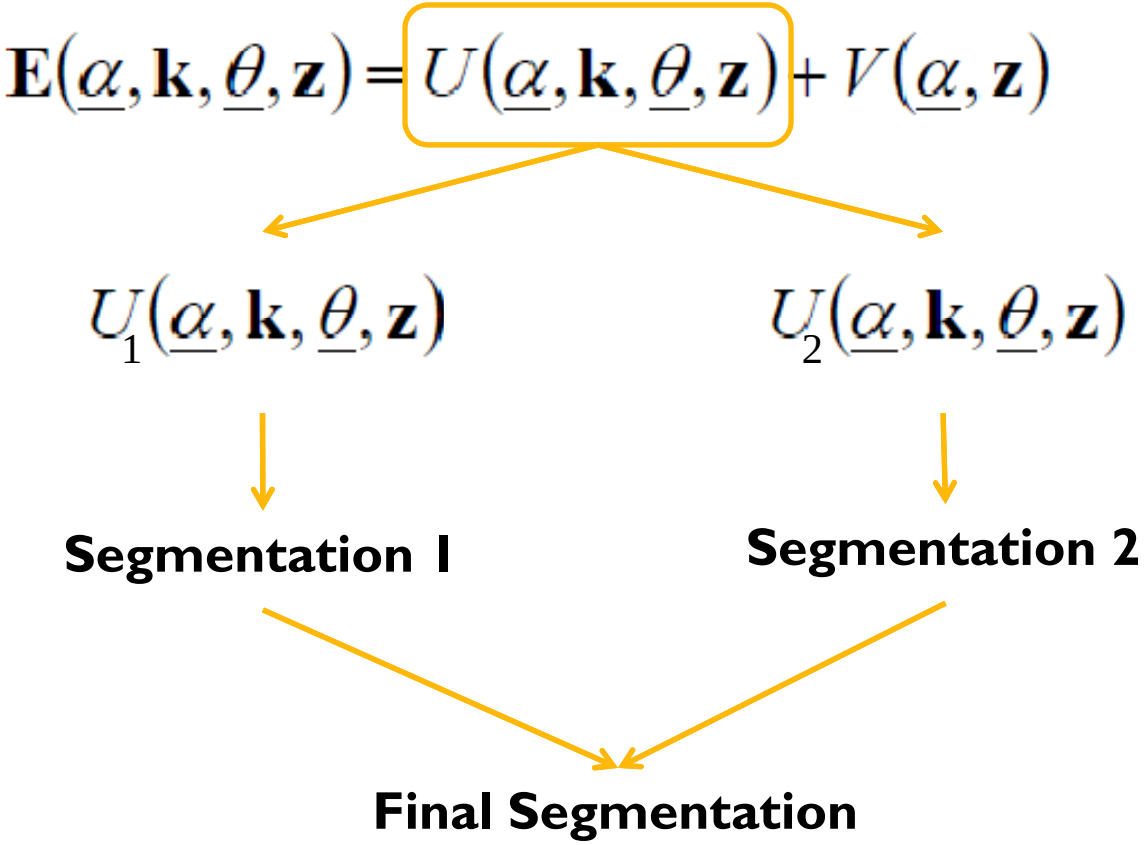
3. Min-cut algorithm



2. Graph representation

Methodology

- Energy function(s)

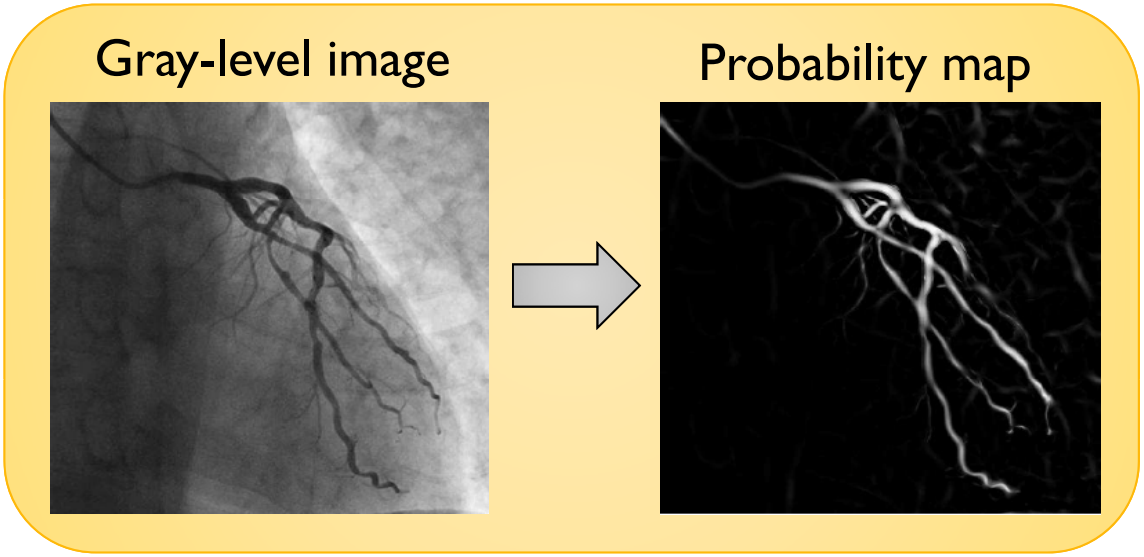


Methodology

- Energy function: Unary potential (I)

$$\mathbf{E}(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) = U(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) + V(\underline{\alpha}, \mathbf{z})$$

Vesselness [1]



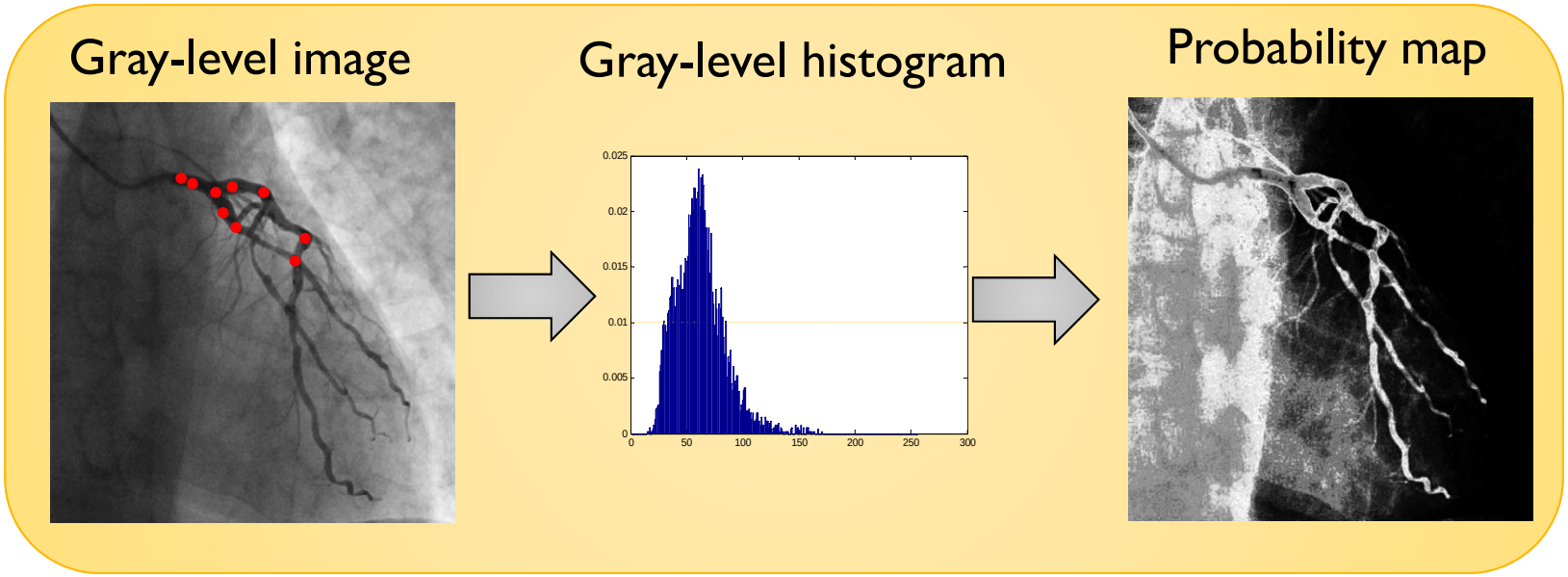
[1] F. Frangi andWiro J. Niessen and Koen L. Vincken and Max A. Viergever, "Multiscale vessel enhancement filtering", *Medical Image Computing and Computer-Assisted Intervention, 1998*

Methodology

- Energy function: Unary potential (II)

$$\mathbf{E}(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) = U(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) + V(\underline{\alpha}, \mathbf{z})$$

Gray-level histograms

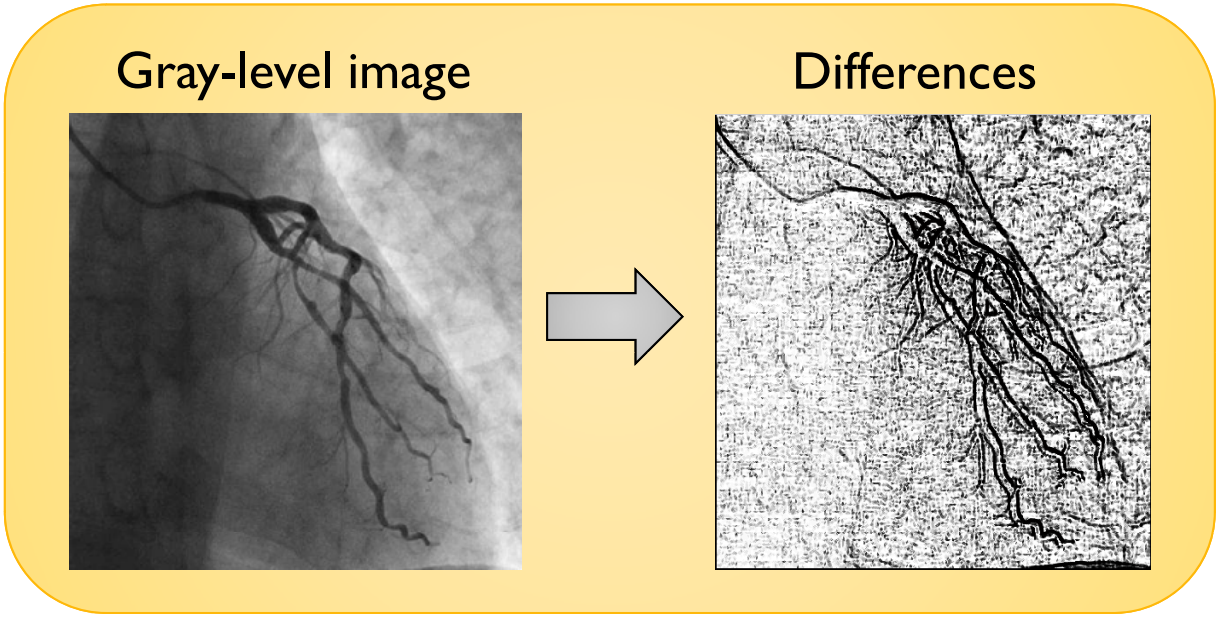


Methodology

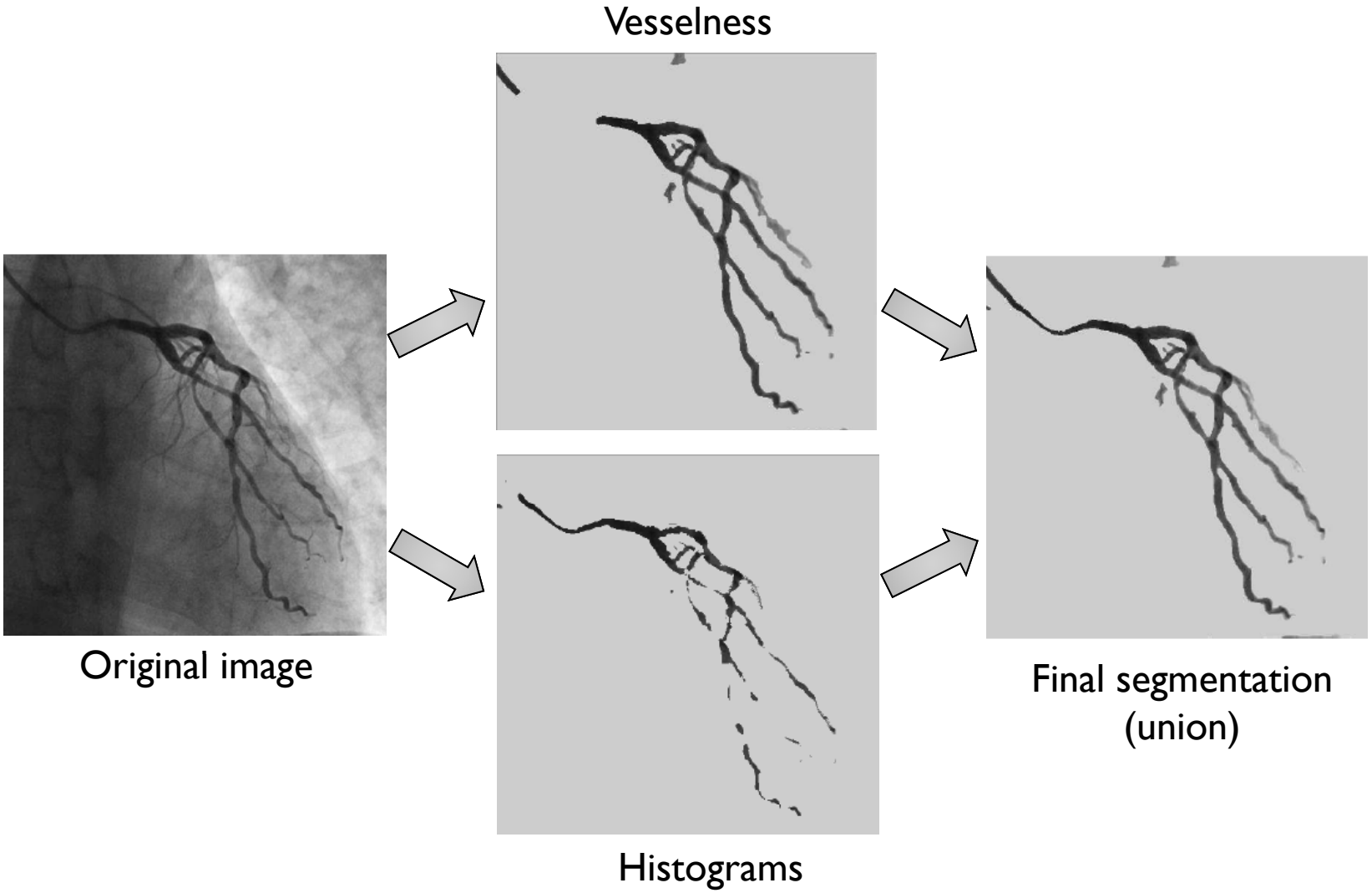
- Energy function: Pair-wise potential

$$\mathbf{E}(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) = U(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) + V(\underline{\alpha}, \mathbf{z})$$

Gray-level differences



Results


Vesselness
Original image
Histograms
Final segmentation
(union)

Conclusion

- Vesselness information is not always enough.
- Gray-level information may introduce errors in low contrasted images.

Future work

- Join vesselness and gray-level information in one potential, finding an appropiate balance.
- Use geodesic paths to refine segmentations.

Thank you!
Questions?

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