Automatic Cochlea Multi-modal Images Segmentation
Using Adaptive Stochastic Gradient Descent

March 2018

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Disclosure

There is no relevant conflict of interest related to this presentation.
Introduction: Problem Definition

- Doctors need cochlea measurement before the surgery to select the best implant for a patient.
- Medical image analysis based on well segmented cochlea may provide these measurements.
- A practical technique to get cochlea segmentation from medical images is needed.
Introduction: Cochlea Segmentation

Input image

Segmentation
Introduction: Cochlea Segmentation Challenges

- Low resolution images, the best spacing we have is [0.125, 0.125, 0.50] mm for CBCT.

- Different types of images CT, MRI and CBCT.

- Cochlea is a small organ with a complicated structure. Cochlea scalas are not visible in the clinical images.
Methods: Adaptive Stochastic Gradient Descent

- An optimizer for medical image registration proposed by Klein et al [1].
- We used it in our method ACIR [2] to solve the problem of cochlea multi-modal image registration and fusion.
- The proposed method is to use ACIR in an model-atlas-based segmentation to solve the problem of cochlea segmentation.

Methods: Adaptive Stochastic Gradient Descent

- ASGD is implemented in elastix, a standard medical image registration tool,[3] which is available as a public open-source.

- ACIR and this work are implemented as 3D Slicer, a standard medical image processing tool, [4] plugins which is also available as a public open-source.

Methods: Cochlea Atlas-based Segmentation

Atlas-based Segmentation

**if:**
Clinical Image A \(\rightarrow\) Can be registered successfully to \(\rightarrow\) Clinical Image B

**this means:**
Segmentation of Image A \(\rightarrow\) Can be registered successfully to \(\rightarrow\) Clinical Image B \(\rightarrow\) To produce \(\rightarrow\) Segmentation of Image B

So all what we need is a good segmentation of the clinical Image A, this can be obtained from a high resolution model.

**if:**
Segmentation of a model \(\rightarrow\) Registration \(\rightarrow\) Clinical Image A \(\rightarrow\) To produce \(\rightarrow\) Segmentation of Image A

**Steps:**
1. Locate the cochlea
2. Cropping
3. ACIR
4. Atlas transformation

Cochlea Segmentation
Methods: Cochlea Model

- A high resolution mCT cochlea image from a public dataset [5] is prepared and used.
- The mCT segmentation is registered to a clinical cochlea image.
- The cochlea clinical image and its segmentation are used as a model.

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Sample results

CBCT  MRI  CT
Conclusion

- A model-atlas-based method for automatic cochlea multi-modal image segmentation is proposed.

- The proposed method segments a cochlea clinical image and generates a 3d model in less than 3 seconds.

- Using higher resolution histology model may provide better segmentation.
Thanks