Automatic Cochlea Segmentation Using Diffusion Snakes

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Introduction:

- A practical technique to get relevant cochlea measurements from medical images is needed.

- Medical image analysis based on well segmented cochlea may provide these measurements.

Segmentation

Input image  
Output image
Active Contours (Snakes) vs Mumford-Shah

Initial Snake

Result
Automatic Cochlea Segmentation using Diffusion Snakes

Diffusion Snakes

- Based on work of Cremers et al [1]. It combined two popular segmentation methods using B-splines.

- Active Contours (Snakes)

- Mumford-Shah (Diffusion)

- Diffusion Snakes Segmentation

- Shape Prior

\[ E(C) = \int \left\{ \frac{\nu}{2} |C_s|^2 + \frac{\mu}{2} |C_{ss}|^2 - |\nabla f(C)|^2 \right\} ds. \]

\[ E(u, C) = \frac{1}{2} \int_{\Omega} (f - u)^2 \, dx + \lambda \frac{1}{2} \int_{\Omega - C} |\nabla u|^2 \, dx + \nu |C| \]

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\[ C_z(s) = \sum_{n=1}^{N} p_n B_n(s) \]

\[ ||C_z - C_z||^2 \]

Diffusion Snakes

1. Add initial Snake
2. Compute Energy terms
3. Update control points
4. Check stopping condition

Segmentation
HCD Dataset

- We used our public Human Cochlea Dataset (HCD) [2].

- It contains pre and post CI multi-modal clinical cochlea images (CT, CBCT & MRI).

Cochlea model

- A high mCT cochlea image is manually segmented and used as a model.
Sample results

Initial Snake  3 iterations  35 iterations  50 iterations
Conclusion

- Automatic cochlea segmentation is challenging.

- The Diffusion Snake method may provide a practical cochlea segmentation.

- Using a shape prior term may help to segment the parts of the cochlea.
Thanks