Evaluation of Design Features in Interactive 3D Tracts-of-interest Selection Tools in DTI



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View Point

View

Outside Factors

Auto-Clusterine

Colorina

Within Dataset

Across Datasets



Research Objective:

This project is motivated by the desire to understand and inspire better tool designs for interactive 3D tracts-of-interest (TOI) selection tools.

We present a set of findings from our two user evaluations of state-ofart TOI selection techniques:

Subjective study of three standard TOI selection tools looking at the utility, usability and user satisfaction with design features

Experiment 1: Subjective User Evaluation

Results



Design Feature

Feedback

Adjustment

Goal

Qualitative evaluation of the utility, usability and user satisfaction with different features of three TOI selection tools: Brainapp, CINCH, and MedINRIA.

User's subjective ratings ranged from 1 to 7, 7 being the best. Our questionnaire considered:

(1) Action Space - features affecting how users interact with the model

User performance evaluation to measure the time performance and subjective reliability of two of the three standard TOI selection tools

TOI Selection Tools Studied









CINCH

Four different fiber bundles chosen in the evaluation

(2) Outside factors - features that assist in the selection process such as visual enhancement

Discussion

Action Space:

- The touch tool was rated highest in all three rating categories
- Shape match and grow/shrink had a high average score of 6 in terms of usefulness. However, the confidence score was rather low, only 2.7 out of 7

Outside Factors:

• The scores for the usefulness of anatomical viewpoint control had the biggest variance range: 2-7

Users had high confidence in the reproducibility of selection result in Brainapp and MedINRIA, but much lower confidence in reproducibility in CINCH

CINCH









Experimental Setup:

- Four domain experts
- All TOI selection tools ran on the same desktop hardware setup

Experiment 2: User Performance Evaluation

TOI Selection Methods



Brainapp

Obtain performance data on TOI selection techniques using controlled tasks in a simplified environment.

Task

Compared user performance in selecting four different fiber bundles using two standard tools: Brainapp and CINCH. The four structures chosen were:

(3) Superior longitudinal fasciculus (SLF)

(1) Corpus collosum (CC)

(4) Uncinate fasciculus (UF)

(2) Cingulum bundle





• DTI scans from a normal subject

Conclusions

- Evaluating and comparing the relative merits of different TOI selection methods leads toward a formal understanding of the state-of-the-art in TOI selection tools
- Relatively simple fixing/erasing mechanisms such as the touch mark in CINCH is very useful

Designers should pay attention to result's reproducibility

Semi-automatic selection algorithms based on embedded information has high potential in creating more efficient tools

We conjecture that this result occurred because:

(1) UF is the outermost part of the frontal lobe in the brain, and a box can be placed at this location without too much occlusion

- unexpected since UF is curvy arc-shaped structure in the frontal lobe

CINCH outperformed Brainapp in all three structures except UF.

(2) Most participants used *shape matching* operation in CINCH to select this special curvy structure. Unfortunately, the algorithm performed poorly in locating this shape.

| -0 - | | | | |
|--------------------------------|----------|------------------|--------------|-----------------|
| | Corpus | Cingulum | Superior | Uncinate |
| | Callosum | Bundle | Longitudinal | fasciculus (uf) |
| | (CC) | fasciculus (slf) | | |
| White Matter Fibertract Bundle | | | | |



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Discussion

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