Enabling Interactive Brain Fiber Tracking with the GPU

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Figure 1. Results interactively generated by our fiber tracking tool.

Introduction

- Fiber tracking [1] makes it possible to determine the position of the fiber bundles in a patient’s brain. This is important for neurosurgeons, since it allows them to make a better planning prior to a surgery.
- Interactivity in fiber tracking applications has been limited so far by the huge amount of calculations required for the process to be executed.
- We have previously shown [2] how fiber tracking can achieve a significant performance gain when run on GPUs with Cg.
- Now we show how a CUDA implementation of fiber tracking allows a tool to find fiber tracts in real-time, thus greatly improving interactivity.

Fiber tracking with CUDA

- Fiber tracking is executed in its entirety on the GPU, while the CPU is responsible for the actual visualization of the resulting fiber tracts.
- The current bottleneck is processing time; data transfer times between CPU and GPU are negligible.
- Fibers are rendered as lines when the user is dragging the volume of interest, and as tubes as soon as the user releases the mouse button.

Results

- Figure 1 shows fiber tracking results interactively created with our tool.
- A video demonstrating a whole exploratory session is available at http://www.lapix.ufsc.br/videos/
- A comparison between fiber tracking on the CPU and on the GPU is given by Table 1. Measures were obtained by sweeping a 10 mm cube through the volume, from bottom to top.
- The GPU implementation outperformed the CPU by more than 10 times on average, and by over 16 times on the worst case.

Table 1. FPS measures for CPU and GPU.

<table>
<thead>
<tr>
<th></th>
<th>Mean FPS</th>
<th>Minimum FPS</th>
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<tbody>
<tr>
<td>CPU</td>
<td>0.99</td>
<td>0.43</td>
</tr>
<tr>
<td>GPU</td>
<td>10.56</td>
<td>7.03</td>
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</tbody>
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Conclusions

- GPUs enable fiber tracking applications to take on a new level of interactivity.

References