Using Desktop Graphics Processors In Diagnostic Medicine

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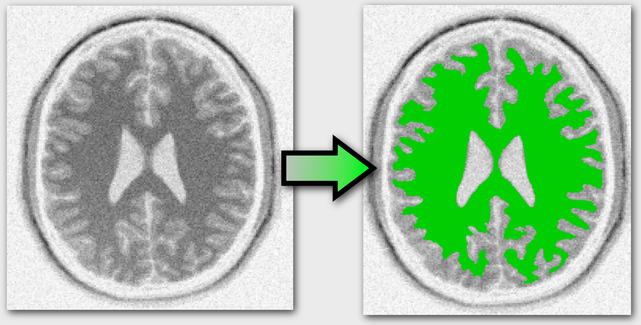
1 Image Segmentation



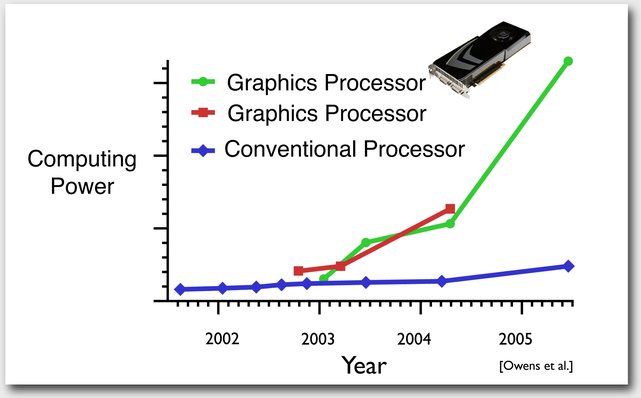
Important task in diagnostic medicine, but...

- Requires expert training
- Very time-consuming
- Doctors typically don't have enough time to perform accurate segmentations

Computers can help, but...

- State-of-the-art computers are too slow
- Need to solve billions of equations

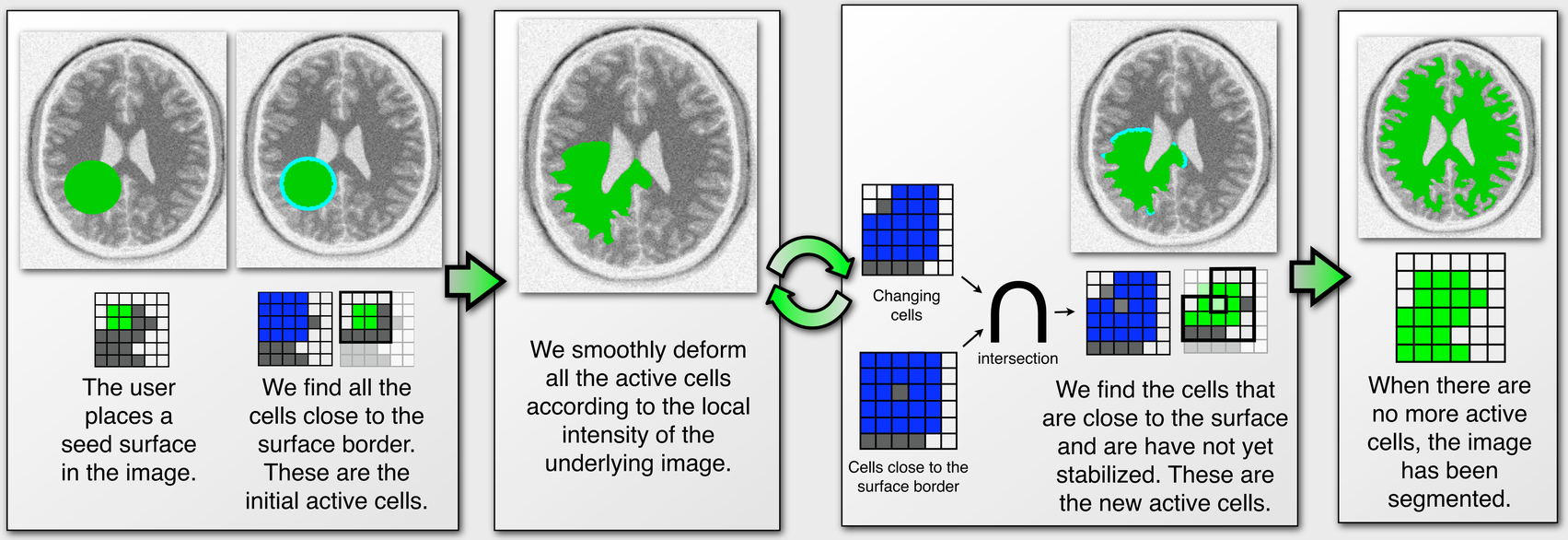
2 Why Graphics Processors?



Rapidly increasing computational power of graphics processors can be harnessed for non-graphics problems

- Requires a new computer programming model where problem is decomposed into millions of identical sub-problems
- Decomposing problems in this way can be challenging

3 Our Approach



4 Results

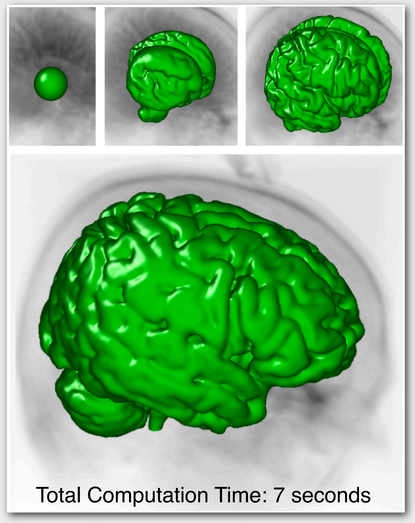


Figure 1: The progression of our algorithm while segmenting the human brain matter in a 256x256x256 magnetic resonance image. The total time required to compute this segmentation is 7 seconds - 14x faster than the previous state of the art with no reduction in accuracy.

Figure 2: The kidneys and aorta from a 256x256x272 computed tomographic image. This segmentation was interactively computed by our algorithm in 15 seconds.

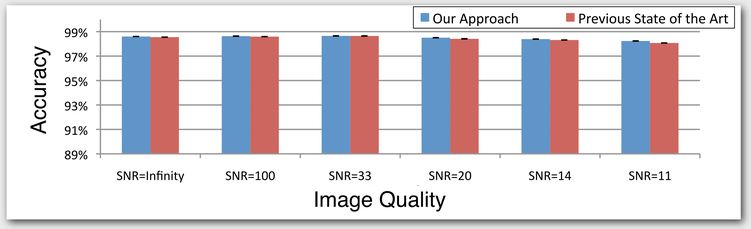


Figure 3: The accuracy, as measured by the total number of correctly labeled image cells, of our approach and the previous state of the art during repeated (N=10) white matter segmentations in a 256x256x256 magnetic resonance image for a variety of image quality levels. SNR is the signal-to-noise ratio. Both approaches are equally accurate.

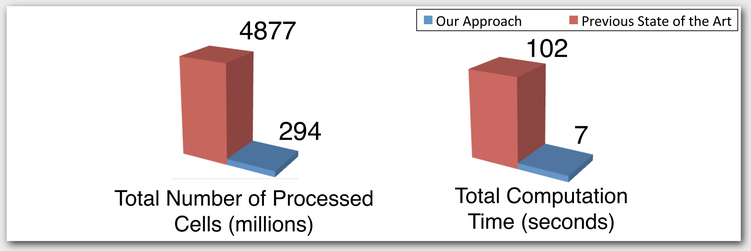


Figure 4: The performance of our algorithm and the previous state of the art when segmenting the brain matter in a 256x256x256 magnetic resonance image, as shown in Figure 1. Our approach reduces the total number of processed cells by 16x and is 14x faster than the previous state of the art. Lower is better for both graphs.

[1] JD Owens, D Luebke, N Govindaraju, M Harris, J Krüger, AE Lefohn, T Purcell. **A Survey of General-Purpose Computation on Graphics Hardware**. *Computer Graphics Forum, 26(1) 2007*
[2] WK Jeong, J Beyer, M Hadwiger, A Vazquez, H Pfister, RT Whitaker. **Interactive Segmentation and Visualization of Neural Processes in EM Datasets**. *IEEE Trans. Vis. Comp. Graphics 15 (6) 2009*
[3] AE Lefohn, JM Kniss, CD Hansen, RT Whitaker. **A Streaming Narrow-Band Algorithm: Interactive Computation and Visualization of Level Sets**. *IEEE Trans. Vis. Computer Graphics 10(4)* 2004

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