Microsoft Research
eXtreme Computing Group

Visualization and Interaction for Business and Entertainment

Animated, Dynamic Voronoi Treemaps

Danyel Fisher Avneesh Sud
{danyelf, avneesh.sud}
@microsoft.com

Why Voronoi Treemaps?

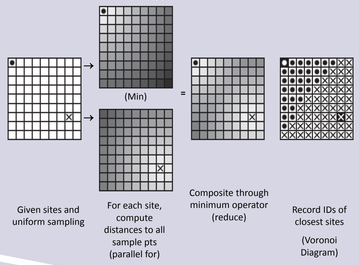
	Slice and Dice	Squarified	Pivot-by-Size	Strip	Spiral	Circle	Voronoi
Aspect Ratio	Terrible	Great	Ok	Ok	Ok	Great	Great
	100+	1.3	2.5	2.3	2.5	1.0	1.3
Zoom	Requires Distortion	Unstable	Unstable	Unstable	Unstable	Great	Great
Dynamism	Great	Terrible	Bad	Ok	Ok	Great	Great
Space Filling	Yes	Yes	Yes	Yes	Yes	No	Yes
Simple Shapes	Yes	Yes	Yes	Yes	Yes	Yes	No

- Good aspect ratio
- Can be zoomed without distortion
- Supports animation

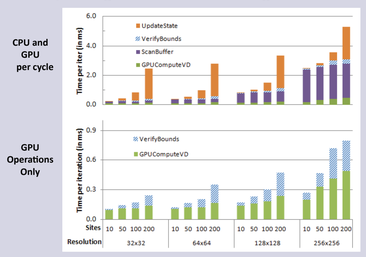
GPU Acceleration

- Discrete approximation
- Iterative step on CPU; Voronoi on GPU
- Fast computation
- Real-time rendering

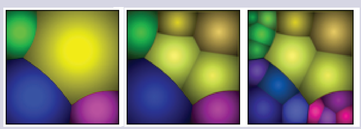
Voronoi Diagrams on the GPU



Computing the Voronoi Diagram is Fast



Hierarchical Refinement



Stencil mask helps accelerate recursive computation: we only need to compute the sites inside the region.

Compute regions at one level. Then, for each child, compute and render regions

	Nodes	Compute Time	Render Time
Balzer	4000	433 sec (8 x 2.4 GHz Xeon)	Unknown
GPU	4681	28.5 sec (1 x Nvidia GTX 260)	78.5 ms

Animation

Stable animation at three successive monthly time points, based on marketing data. These frames were extracted from a video spanning nine months.

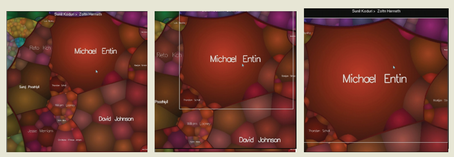
Re-Seeding on Update

End of the previous iteration: Voronoi seeds located around centroid the parent

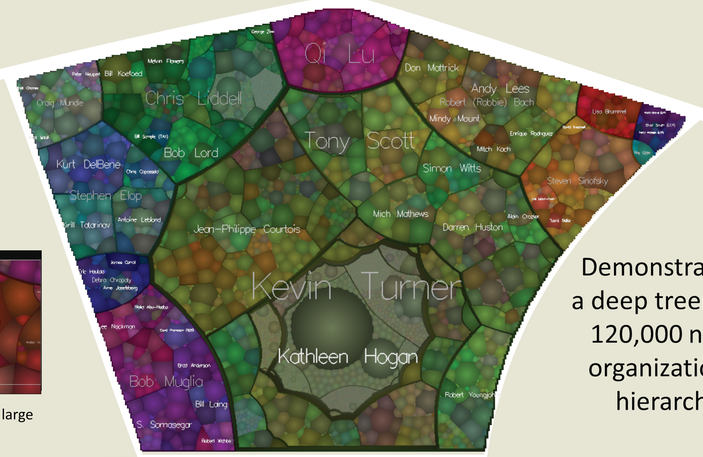
Hierarchical placement: The parent has new boundaries (blue). Place seeds relative to new boundaries

New seeds: Regions are generated based on parent boundaries

Smooth Zooming



Iteratively zooming in on the note “Michael Erin” from a very large treemap of 120000 nodes.



Demonstrating a deep treemap: 120,000 node organizational hierarchy

References & Further Reading

A. Sud, D. Fisher, and H.-P. Lee. “Fast Dynamic Voronoi Treemaps.” *Proceedings of the International Symposium on Voronoi Diagrams in Science and Engineering 2010*. Quebec, Canada: IEEE Computer Society. June 28-30.

M. Balzer and O. Deussen, “Voronoi treemaps,” *IEEE InfoVis*. Los Alamitos, CA, USA: IEEE Computer Society, 2005.

A. Sud, N. Govindaraju, and D. Manocha, “Interactive computation of discrete generalized voronoi diagrams using range culling,” *Proceedings of the International Symposium on Voronoi Diagrams in Science and Engineering*, October 2005