IMMERSIVE INTERFACES FOR IMPROVING THE SCIENTIFIC INQUIRY PROCESS

Patrick O'Leary, William Sherman and Oliver Kreylos

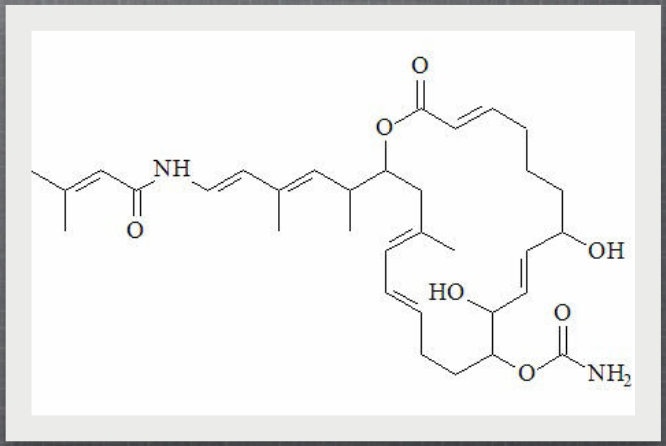
ANTARCTIC TUNICATE (SEA SQUIRT)

- Abundant marine animal in antarctic subtidal waters
- Bacterial symbionts

PALMEROLIDE A

- A natural product
- A biomolecule
- A bioactive

Inhibits growth of cancerous cells (Diyabalanage et al. 2006)
Tested against ~60 cell lines, including human, with encouraging results
Parallel studies: chemical synthesis and biosynthesis



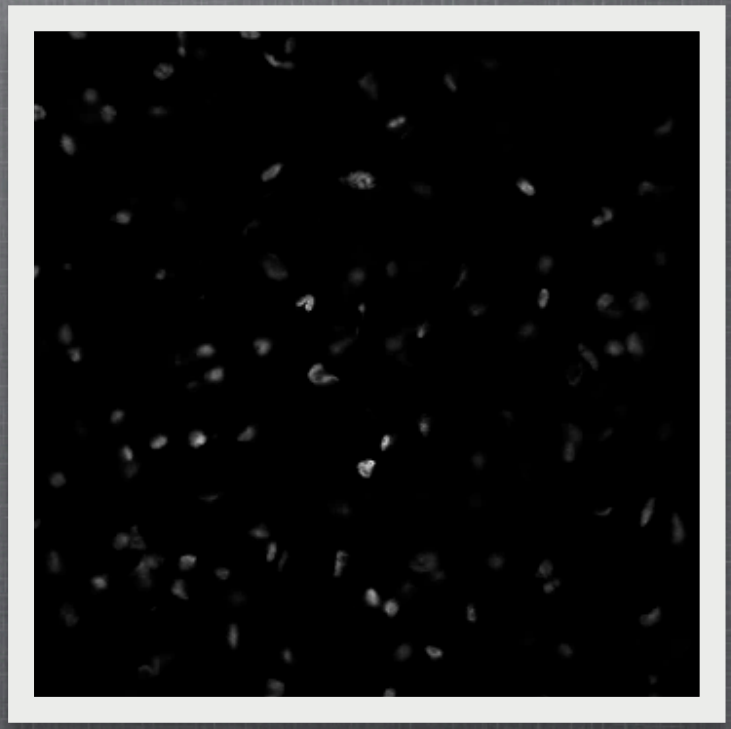
SCIENTIFIC WORKFLOW

1/2 day to

- Cross section tunicate tissue
- Label cells with fluorescent dyes

A few days to

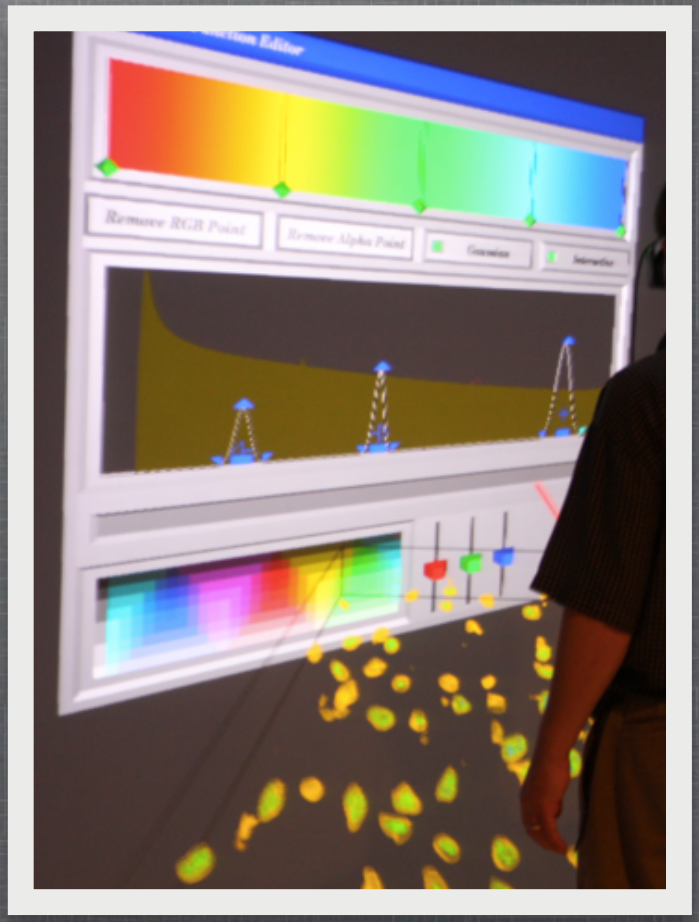
- Count cells ...



MOTIVATION

Developing tools for extracting data from the image

- Interact with image
- Enumerate different cell size and morphology
- Tag individual cells

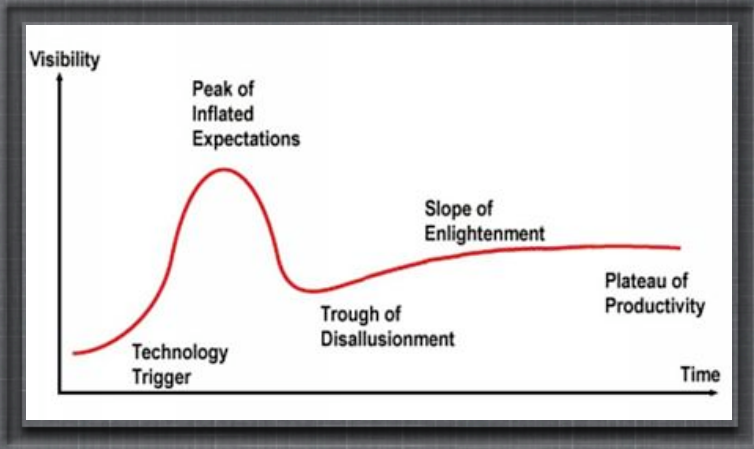


IMMERSIVE ENVIRONMENTS (AKA VIRTUAL REALITY)

"Virtual reality is a medium composed of interactive computer simulations that sense the participant's position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation." from Sherman and Craig

TECHNOLOGY INSERTION CURVE

Technology Trigger - 1989 VPL Research, Inc. (Affordable Hardware)
Peak of Inflated Expectations - 1992-95
Trough of Disillusionment - 1995-98
Slope of Enlightenment - It's still around
Plateau of Productivity



IMMERSIVE INTERFACES

Fundamental requirements for creating scientific workflows using immersive interfaces

- Virtual Reality toolkit
- Advanced visualization
- Direct manipulation

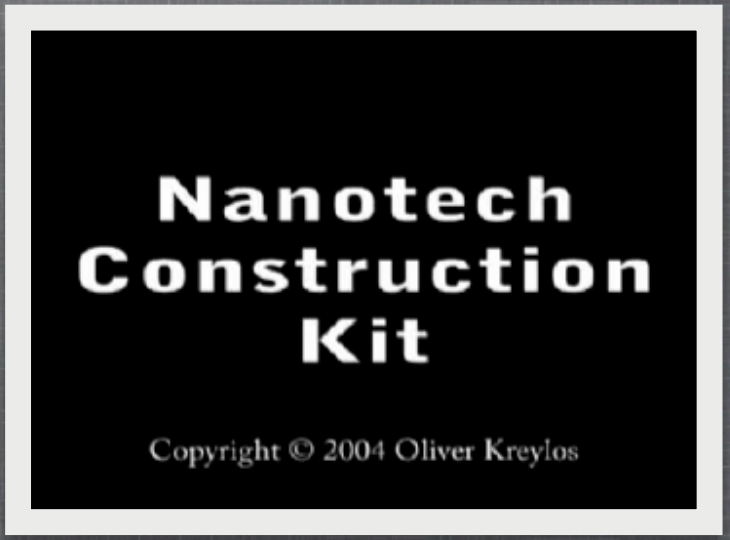
VR TOOLKIT

Virtual reality user-interface (Vrui) toolkit - Kreylos et al. 2006

- 'Data at the users fingertips' Paradigm
- Scales from the a laptop to large immersive environments

FreeVR - Sherman

- Open-source replacement for the CAVElib
- 'Immersed in the data' Paradigm
- Scales from the laptop to large immersive

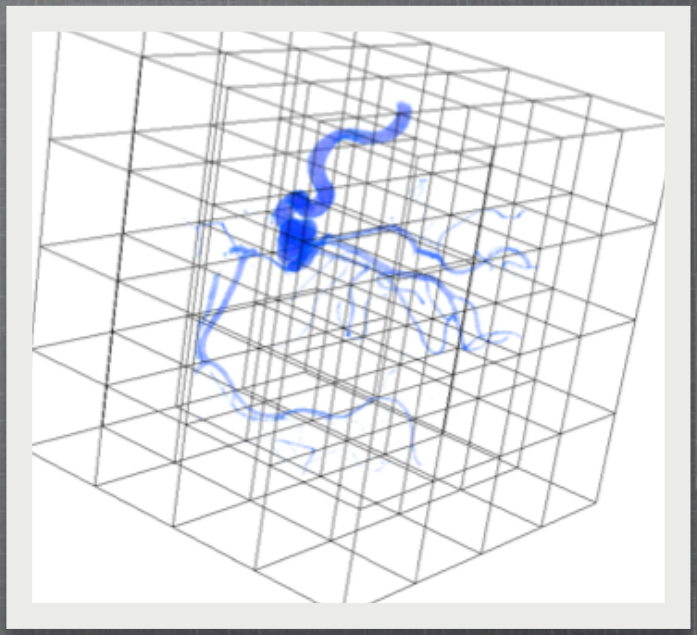


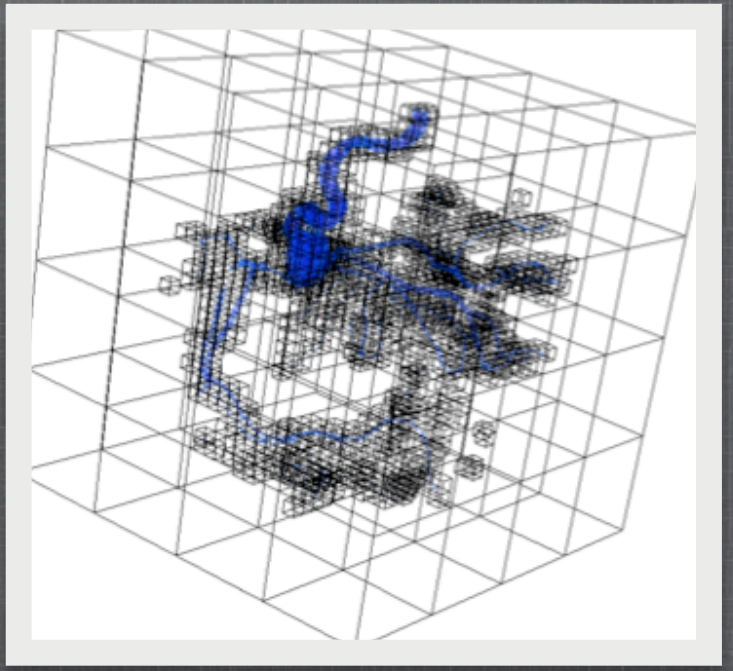
ADVANCED VISUALIZATION

Heterogeneous data structures - Ruijters and Vilanova 2006

- Bricks - Coarse-scale space leaping
- Octree - Fine-scale space leaping

GPU View-aligned slicing - Rezk-Salama and Kolb 2005

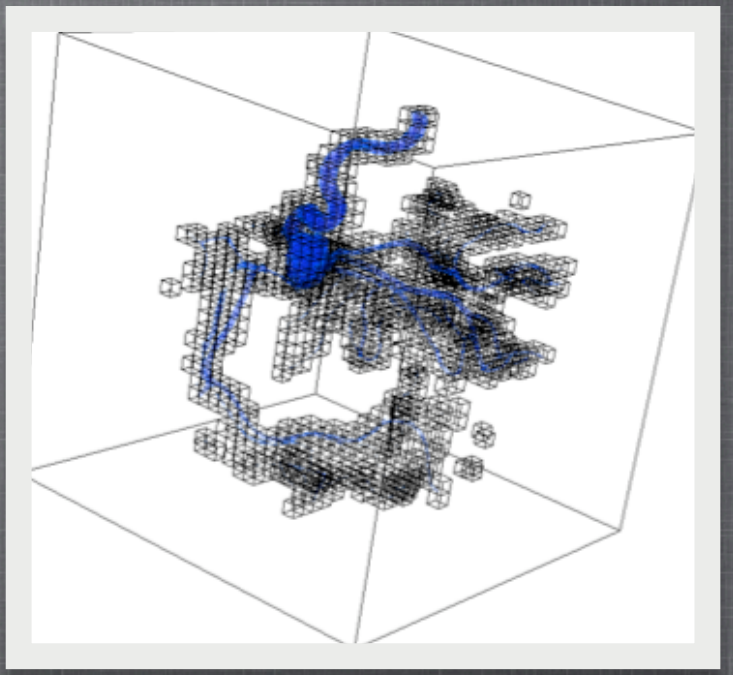


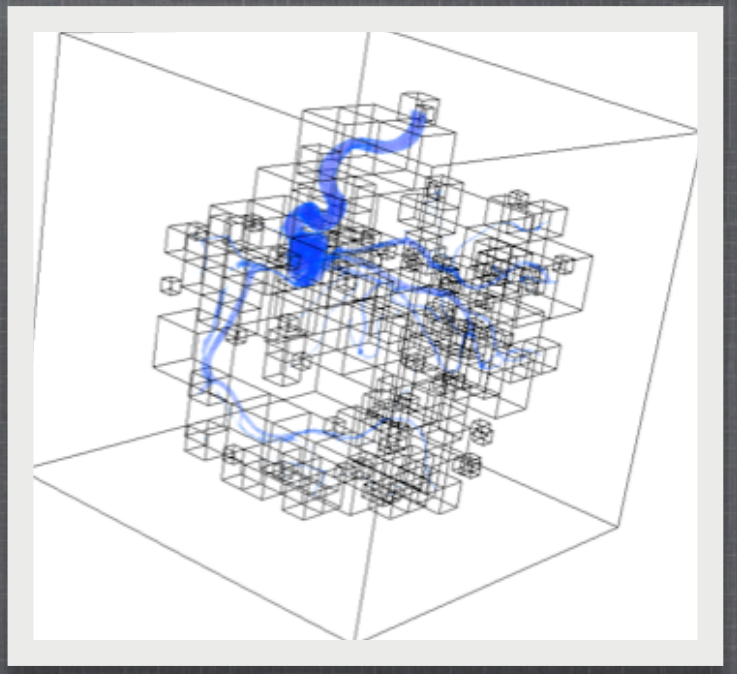


TERMINATION CRITERIA

Octree traversal termination criteria has a significant performance impact

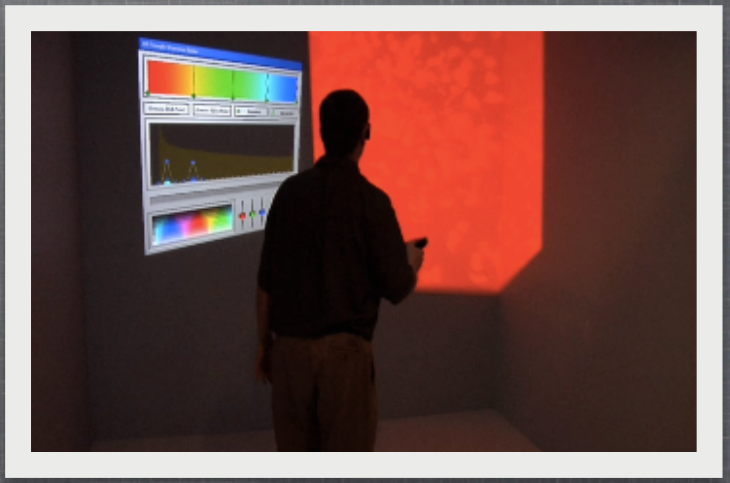
- Ratio of visibility
- Substantial improvement greedy-1 algorithm





DIRECT MANIPULATION

- Explore
- Interact with image
- Enumeration of different cell size and morphology
- Tag individual cells



CONCLUSIONS

- Open new avenues to Palmerolide A biosynthesis
- Excited about potential time savings and improved analysis
- Domain scientists involvement in tool development process