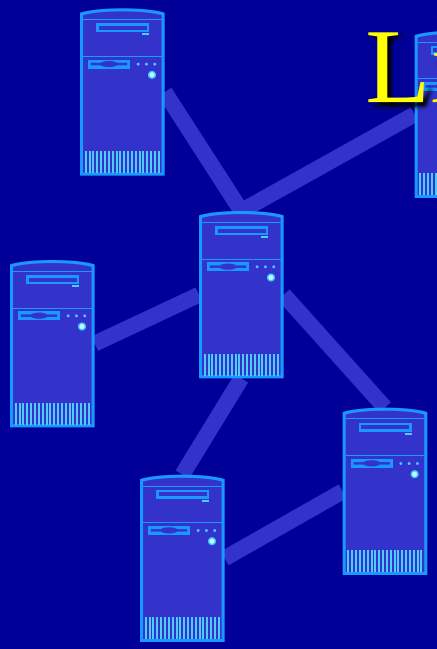
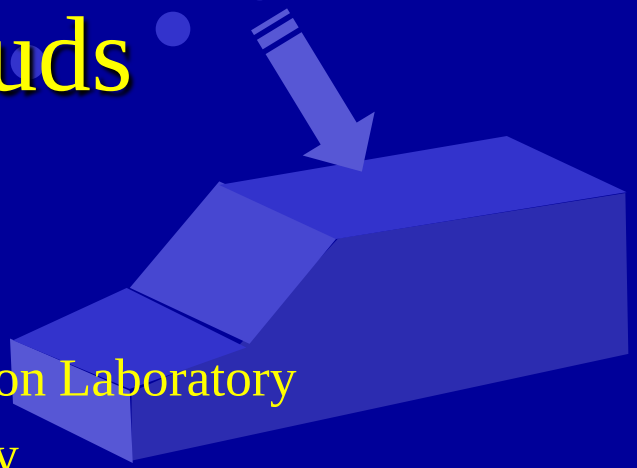


Linux Clustering Software
+
Surface Reconstruction from Point Clouds



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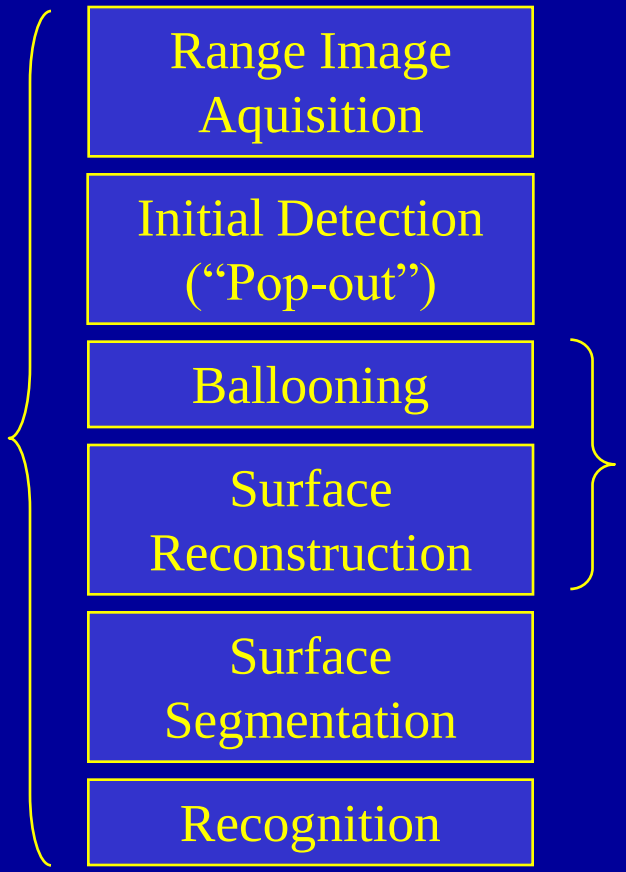
07 Feb 2002

Topic Motivation

- Computationally intensive work
- Many “small” execution jobs at each phase



Multiple balloons must be merged:

- Segmentation requires dense meshes
- Non-sparse balloons are “leaky”
- Merging overlapping balloons is non-trivial

Outline

- Part 1: Linux Clustering Software
  - ClusterIt
  - Portable Batch System
- Part 2: Surface Reconstruction
  - Preliminaries
  - Curve Reconstruction
  - Cocone Algorithm
  - Undersampling
  - Some Results
- Current Status
- Further Reading

Cluster Software:

ClusterIt

- What is it?
  - Simultaneous execution on a set of Linux boxes
  - Execution on “any” Linux box
    (but PBS is much better)
- What do I have to do to use it?
  - See http://sampl.eng.ohio-state.edu/~dalleyg/faq/index.html for instructions on configuring SSH

Cluster Software:

SAMPL Cluster Groups

Group	Comments
a	All processors (use with *jsd*, etc.)
a1	**All boxes (use with *dsh*, etc.)**
b	All Beowulf processors
b1	**All Beowulf boxes**
m	**All of the Micron boxes**
dc	All processors on the dual Celerons
dc1	All dual Celeron boxes

See **`/etc/dsh.cluster`** on a Linux box for the full set of groups

Cluster Software: dsh

- When would I use it?
  - Same command, many machines
  - Batch job preparation
  - Administrative work

- Usage
  - `dsh -g om 'hostname -i'`

    Group (required!) *Remote command (quoted)*

  - Results

```
sampl01: 164.107.162.9
sampl02: 164.107.162.10
sampl10: 164.107.162.18
sampl12: 164.107.162.20
```

Cluster Software:

dsh Examples

- Good examples
  - `dsh -g om 'hostname -i'`
  - `dsh -g om 'hostname > /tmp/tmpfile'`
  - `dsh -g a1 'smbmount //samplf04/dalleyg /u/dalleyg -o umask=077,dmask=077, password=PASSWORD'`
- What to be careful about
  - Using quotes (single or double)
  - Redirecting input or output

Cluster Software:

Other ClusterIt Examples

- **`pcp -g a1 datafile /tmp/datafile`**
  - Copies file **`datafile`** from the current directory to **`/tmp/datafile`** on all machines in the **`a1`** group
  - Useful for copying files to local temporary storage
- **`prm -g a1 /tmp/datafile`**
  - Deletes **`/tmp/datafile`** on all machines in the **`a1`** group
  - Useful for cleanup of local temporary storage, etc.

Cluster Software:

Portable Batch System

- What is it?
  - Manages submission and execution of large batch jobs
  - Allows balancing between users
  - Used for single multi-processor machines all the way up to compute farms with many Crays (e.g. OSC)

Cluster Software:

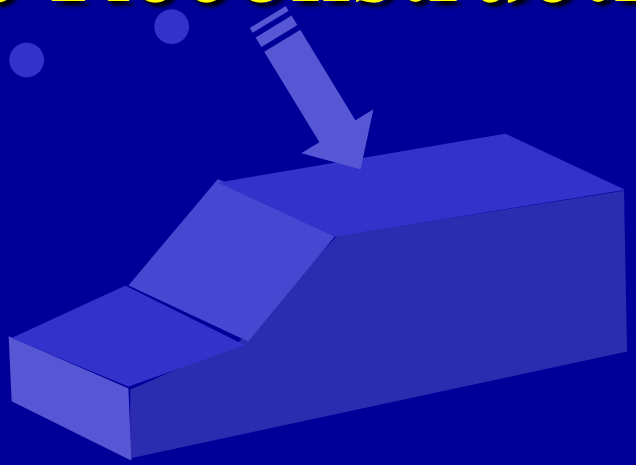
Portable Batch System (cont'd.)

- Submitting a job (from *eepc359* **only**)*
  - **`qsub -N jobname jobprogram`**
  - **`qsub -N Test /home/dalleyg/nfs/test2.pl`**
- Cluster status
  - **`qstat -f -B`**
- **`xpbs`**
  - Helps you create job scripts, configure advanced options, etc.
- **`xpbsmon`**
  - Helps you monitor the state of the machines on the cluster

*The configuration is still being debugged.

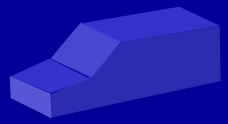
Part 2:

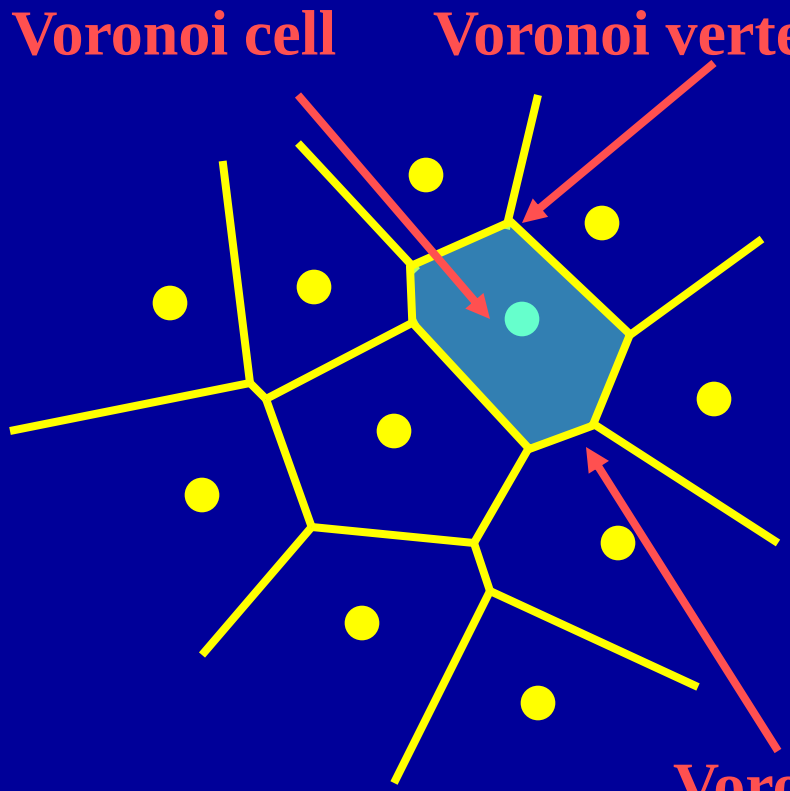
Surface Reconstruction…



Surface Reconstruction Preliminaries:

Voronoi Diagrams

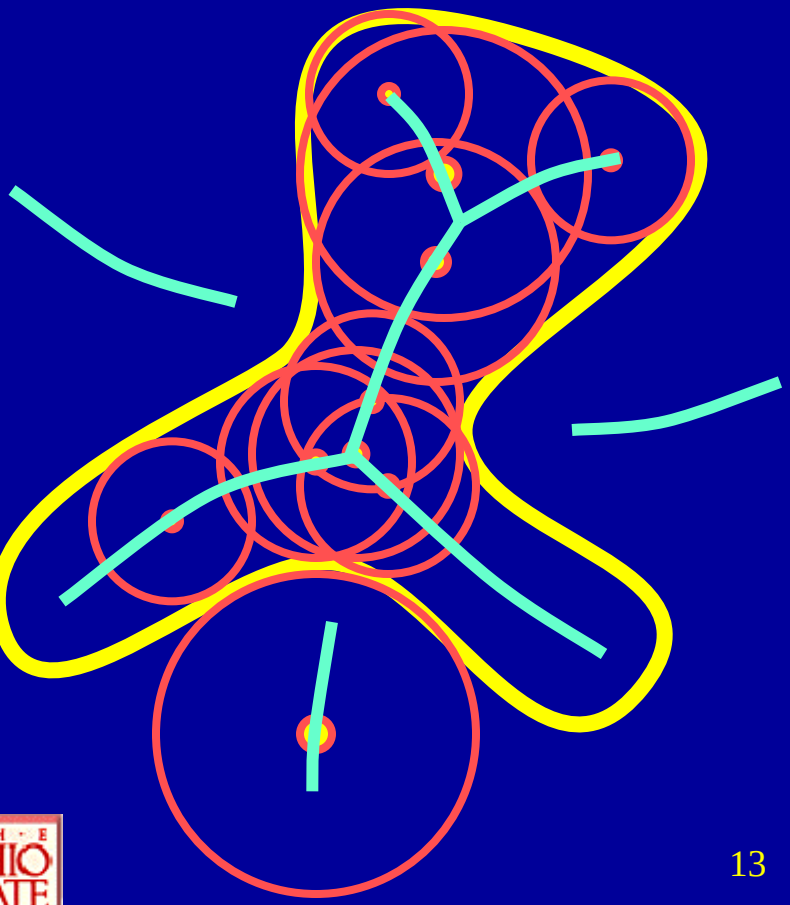




- Voronoi Cell of ***x***
  - The set of points that are closer to ***x*** than to any other sample point

Surface Reconstruction Preliminaries:

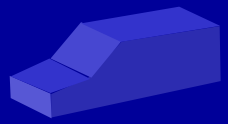
Preliminaries: Medial Axis

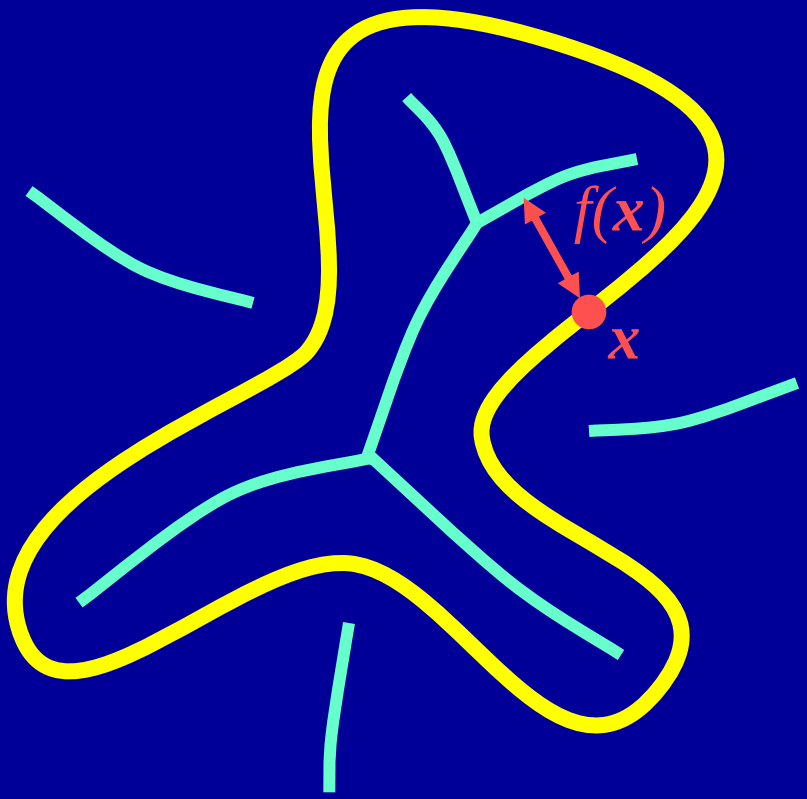


- Medial Axis:
  - Find all circles that tangentially touch the curve in at least 2 points
  - Medial axis = centers of all those circles

Surface Reconstruction Preliminaries:

ε-sampling





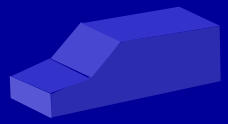
$f(x)$ ≡ feature size at point x
= distance to the medial axis at point x

Sampling criterion:
each sample point x is at most $\varepsilon f(x)$ from the next closest sample ($0 < \varepsilon < 1$, typically).

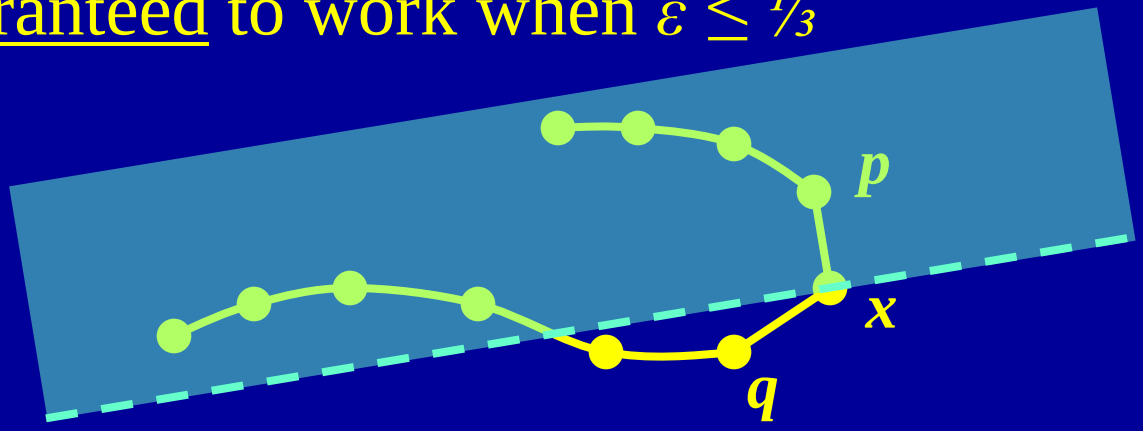
Important note: When ε is small, the curve locally looks flat

Surface Reconstruction:

Curve Reconstruction

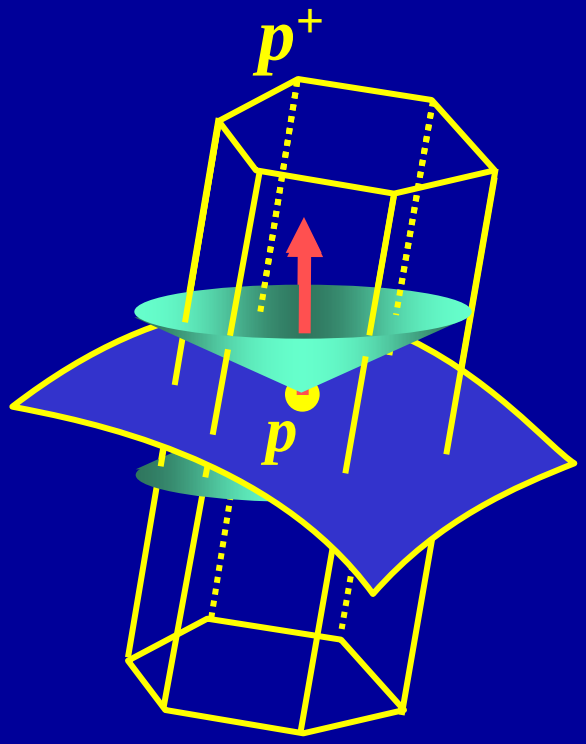


- Algorithm:
  - Find the closest point, ***p***, to ***x*** and connect them
  - Find the closest point, ***q***, to ***x*** such that the angle ***pxq*** is at least 90°.
- <u>Guaranteed</u> to work when $\varepsilon \leq 1/3$



Surface Reconstruction:

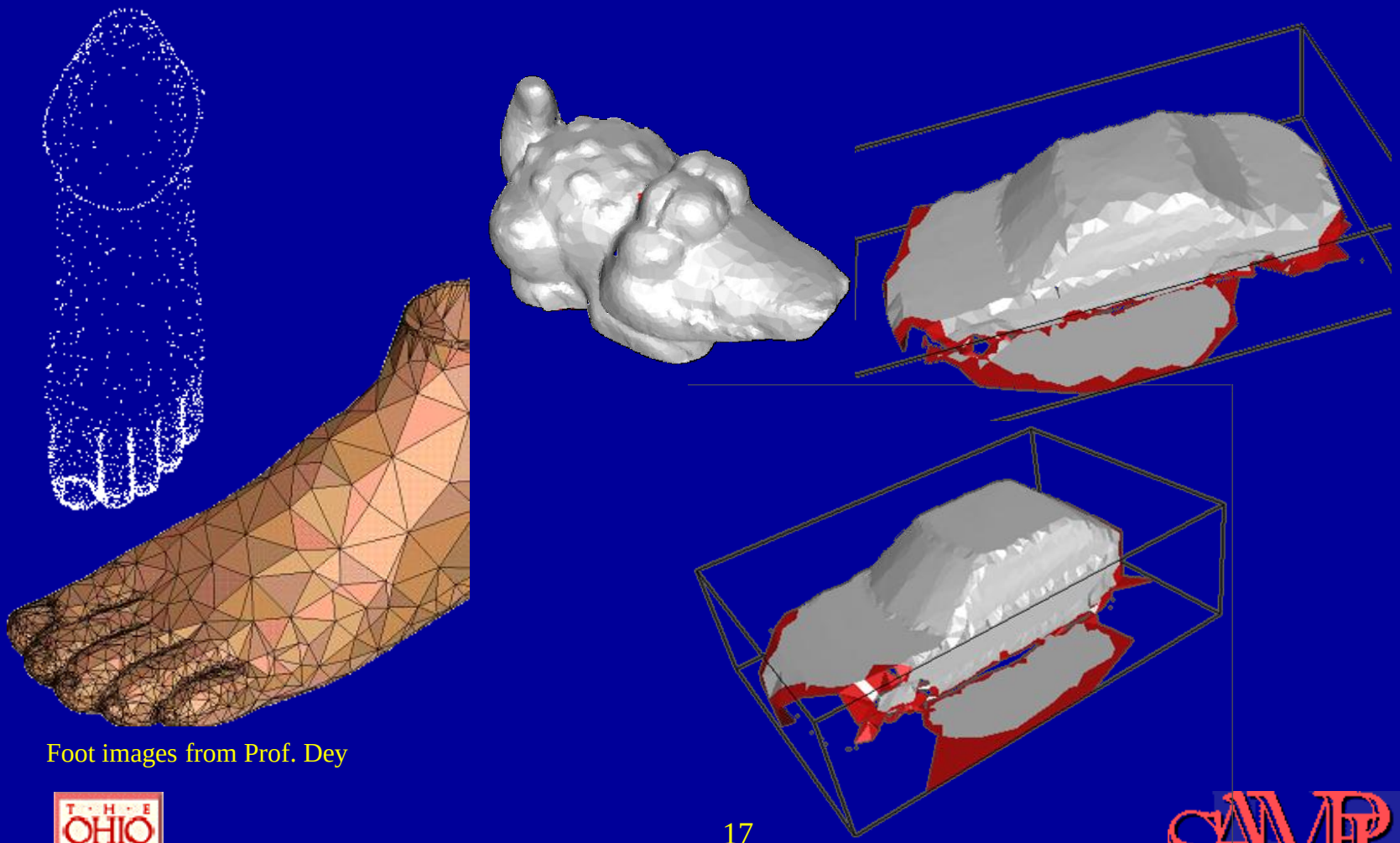
Cocone Algorithm



Voronoi cell of p

- $p^+ \equiv$ pole of p = point in the Voronoi cell farthest from p
- $\varepsilon < 0.1 \rightarrow$
  - the vector from p to p^+ is within $\pi/8$ of the true surface normal
  - The surface is nearly flat within the cell

Sample Reconstructed Surfaces



Foot images from Prof. Dey

TuT Status

Range Image Aquisition	Software written
Initial Detection (“Pop-out”)	See Kanu
Ballooning	Software written (by Kanu), generating data
Surface Reconstruction	Software written (by Prof. Dey)
Surface Segmentation	Evaluating several variants
Recognition	To be done

Further Reading

- Clusterit
  - http://www.garbled.net/clusterit.html
  - http://sampl.eng.ohio-state.edu/~dalleyg/faq/index.html
- Portable Batch System
  - http://www.openpbs.org
    - Official web site (ask if you need the password)
  - http://www-itg.lbl.gov/Grid/public/pbs/pbs.v2.3_admin.pdf
    - Detailed administration/usage guide
  - http://www-math.cudenver.edu/~jmandel/mri/Schedulers-overview.pdf
    - Slideshow introduction to PBS by Doug Johnson from the Ohio Supercomputer Center
- Surface Reconstruction
  - http://www.cis.ohio-state.edu/~tamaldey/
  - N. Amenta, S. Choi, T. K. Dey and N. Leekha. A simple algorithm for homeomorphic surface reconstruction. Proc. 16th ACM Symposium on Computational Geometry, 2000, 213--222.