An Architecture for Access To A Compute Intensive Image Mosaic Service in the NVO

G. B. Berriman, D. Curkendall, J. Good, J. Jacob, D.S. Katz, M. Kong, S. Monkewitz, R. Moore, T. Prince, R. Williams
National Virtual Observatory Data Grid

1. Portals and Workbenches

2. Knowledge & Resource Management
   - Concept space

3. Catalogs
   - Metadata View
   - Data View
   - Catalog Analysis
   - Bulk Data Analysis

4. Grid Security
   - Caching Replication
   - Backup Scheduling

5. Information Discovery
   - Metadata delivery
   - Data Discovery
   - Data Delivery

6. Catalog Mediator
   - Data mediator
   - Catalog/Image Specific Access

7. Compute Resources
   - Derived Collections
   - Catalogs
   - Data Archives
**Montage - Custom Image Mosaics**

http://montage.ipac.caltech.edu

- User specified size, WCS projection, coordinates, spatial sampling, rotation
- Rectification of backgrounds in images
- Supports drizzle algorithm

**Science Drivers:**
- Science Grade Images
- Analyze diverse images as if part of same “multi-wavelength image”

**Delivery:**
- Semi-annual deliveries from Feb 2003
- Final Delivery Jan 2005
- Available for download
Arbitrary Input Image

FITS header defines output projection

Central to the algorithm is accurate calculation of the area of spherical polygon intersection between two pixels (assumes great circle segments are adequate between pixel vertices)

Input pixels projected on celestial sphere

Output pixels projected on celestial sphere

Reprojected Image

Total Flux
Sky Area Coverage (steradians)
Coordinated Execution Across Multiple GRID Processors

Input Images

FITS header

Simple coadd for final mosaic (sky areas used as weights)

Reprojected Images

Montage Parallelization

mProject

mProject

mProject

mAdd
Montage Background Correction Procedure

A correction is calculated for each image based on all the differences between it and its neighbors (an approximation to a least squares fit to the difference data with brightness outlier pixels excluded). The correction is currently a plane but could be a higher order surface.

This is done for all images, then half the correction determined is applied (to a parameter database; equivalent numerically to applying it to the images).

The process is iterated until step differences for all images becomes small.
Montage Background Correction Results

Reprojected Background Corrected Images
Deployment of Montage

Performance Goal:
Sustain a throughput of at least 30 square degrees per min on 1024 x 400 Mhz R12K O3000 or equivalent

Deploy operationally on the Teragrid by January 2005

Teragrid will be used by NVO for compute intensive services
Managing Requests For Compute Intensive Services

- Access compute intensive service or bulk data delivery service from existing clients
- Apache has no memory of requests, and so little control of multiple time intensive requests:
  - restart automatically after failed request
  - stop large requests as needed
  - monitoring of requests
  - load balancing

Solution:
Request Object Management Environment
What Is ROME?

- Application of *Enterprise Java Bean* e-business technology
  - Used everyday by e.g. banks to manage secure financial transactions
  - Mature technology based on specialized Java Virtual Machine, the EJB server
  - EJB’s manage and persist transactions, perform load balancing, handle security

- Middleware that sits between client and processor whose role is straightforward
  - Accepts requests from clients through standard interfaces
  - Registers them in database
  - Sends them for processing
  - Capable of managing very large numbers of requests