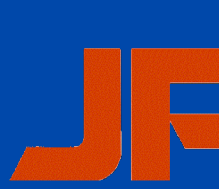
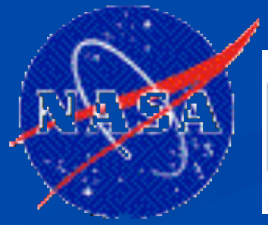
A Grid-Enabled Engine for Delivering Custom Science-Grade Images on Demand

http://montage.ipac.caltech.edu





Les Montagiers

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What is Montage?

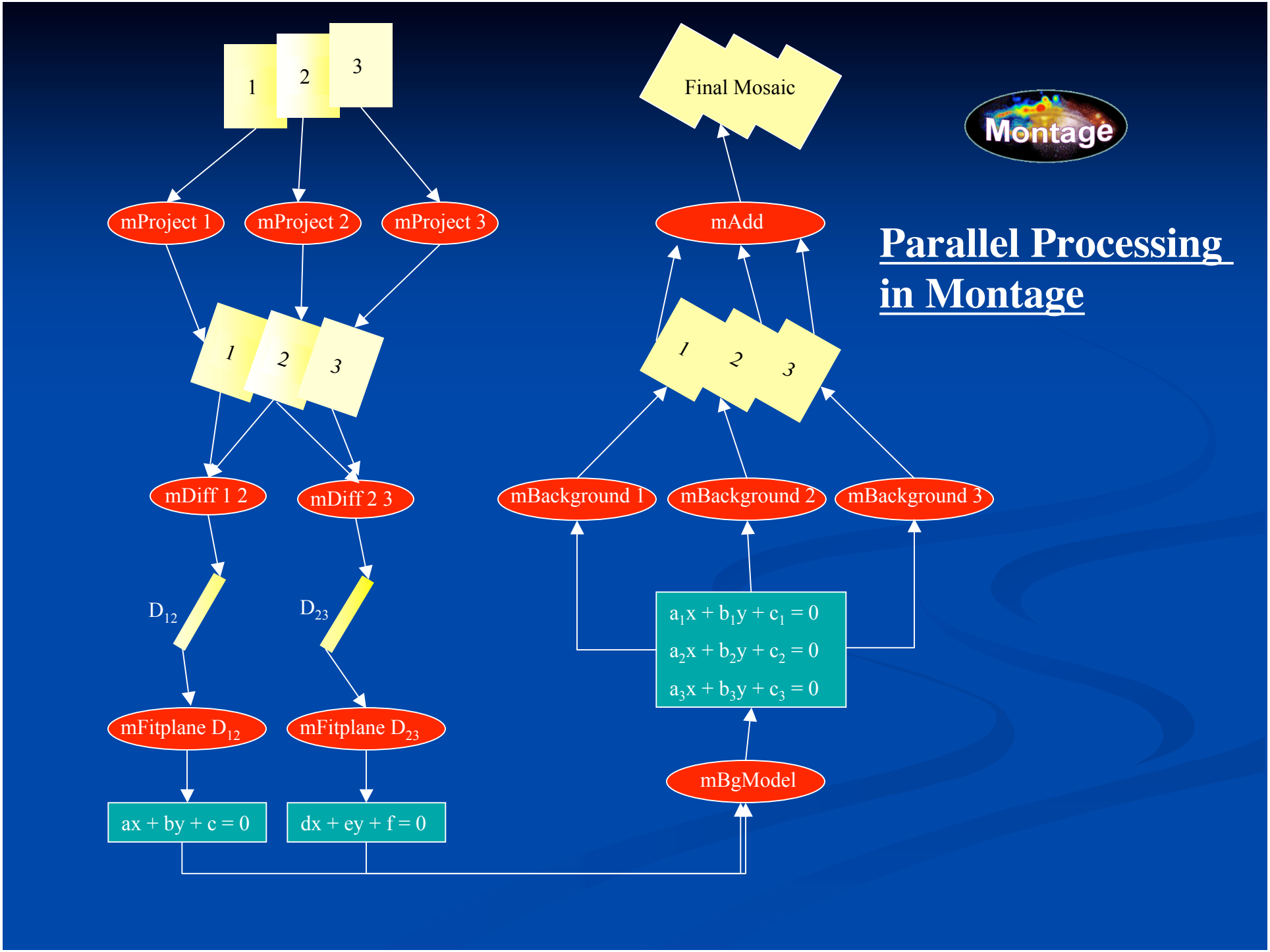
- Delivers custom, science grade image mosaics
  - User specifies projection, coordinates, spatial sampling, mosaic size, image rotation
  - Preserve astrometry & photometric accuracy
  - Modular "toolbox" design
    - Loosely-coupled Engines for Image Reprojection, Background Rectification, Image Co-addition
      - Control testing and maintenance costs
      - Flexibility; e.g custom background algorithm; use as a reprojection and co-registration engine
    - Implemented in ANSI C for portability
  - Enabling technology for multi-wavelength image federation
- Public service will be deployed on the *Teragrid*
  - Order mosaics through web portal

Serial Processing of Images - Version 1.7

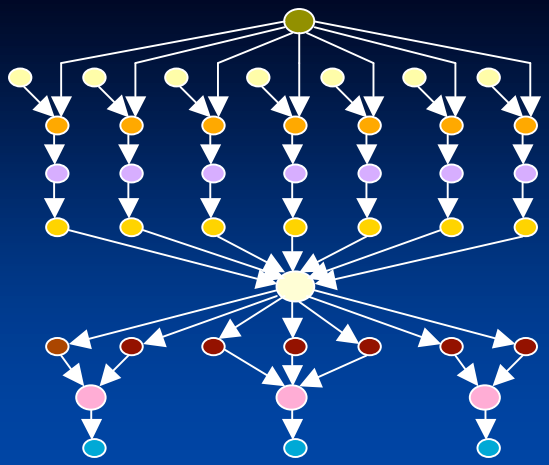
- Available for download via a clickwrap license issued by Caltech at *http://montage.ipac.caltech.edu*
  - User's Guide
- Emphasizes accuracy in photometry and astrometry
  - Images processed serially
  - Reprojection performed on surface of sphere
- BUT generality at expense of speed
- AND mosaic size limited to available memory

- Performance
  - Mosaic of 54 2MASS images, 1 deg x 1 deg
  - Pentium-4 2.26 GHz, 1 GB RAM

Reprojection	5500 s
Background Modeling	55 s
Rectification	28 s
Co-addition	11 s


1
2
3
Final Mosaic
Montage
mProject 1
mProject 2
mProject 3
mAdd
Parallel Processing in Montage
1
2
3
1
2
3
mDiff 1 2
mDiff 2 3
mBackground 1
mBackground 2
mBackground 3
D12
D23
a1x + b1y + c1 = 0
a2x + b2y + c2 = 0
a3x + b3y + c3 = 0
mFitplane D12
mFitplane D23
mBgModel
ax + by + c = 0
dx + ey + f = 0

Montage on the Grid (Version 2.0)



Montage Workflow Specification (abstract)

Maps an abstract workflow to an executable form

Pegasus

Grid Information Systems

Information about available resources, data location

Executes the workflow

Condor DAGMan

Grid

Teragrid Performance

Job	# Jobs	Avg Run Time (s)
mAdd	1	94
mBackground	180	2.64
mBgModel	1	180
mConcatFit	1	9
mDiff	482	2.89
mFitplane	483	2.55
mProject	180	131
Data Transfer In	183	5-30
Data Transfer Out	1	1080

2 deg x 2 deg 2MASS mosaic of M16

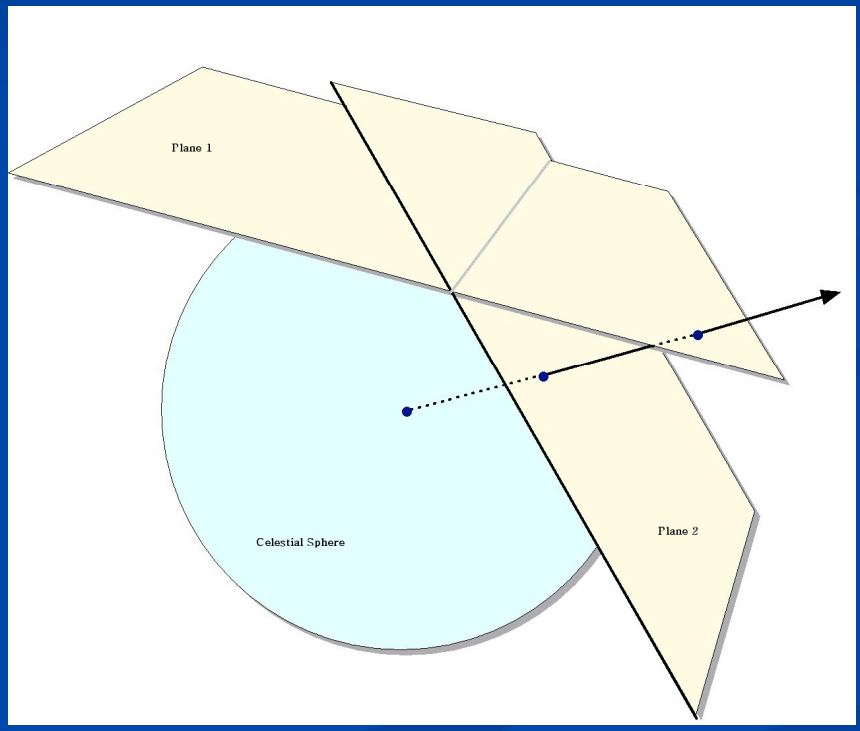
Workflow Run Time: 107 min (1515 jobs)

Exposes highest degree of parallelism

Overhead in scheduling lots of small jobs => Reduce overheads by aggregating modes

Custom Reprojection Algorithms

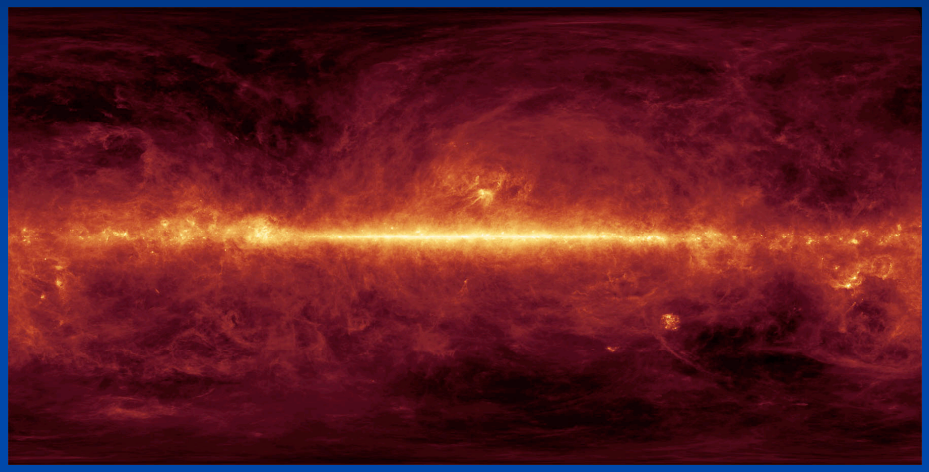
- Transform directly from input pixel to output pixels
  - Approach developed by Spitzer for tangent plane projections
  - Augment with "distorted" gnomonic projections
    - Pixel locations distorted by small distance relative to image projection plane
  - **Performance improvement in reprojection by x 30**



AND Co-addition no longer limited by memory - output images read into memory one line at a time, co-added and written to disk

=> 30% performance degradation acceptable

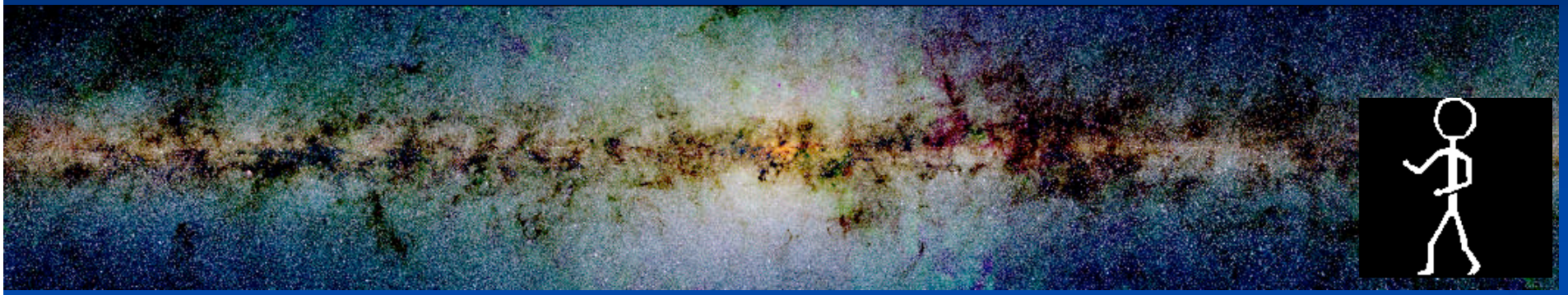
Montage As A Reprojection Engine



100 µm sky; aggregation of COBE and IRAS maps.
(Schlegel, Finkbeiner and Davis, 1998)

- Application of general reprojection engine
  - ZEA to CAR
- Supports a science service required by *Herschel*
  - Serve spatial subsets of the images
  - Dust emission, galactic emission and extinction along line of sight
- E/PO products - fold-out icosahedrons

Generation of Large Scale Mosaics



- 2MASS 3-color mosaic of galactic plane
  - 44 x 8 degrees; 36.5 GB per band; CAR projection
  - 158,400 x 28,800 pixels; covers 0.8% of the sky
  - NVO compliant-service
  - 4 hours wall clock time on cluster of 4 x 1.4-GHz Linux boxes
- Pilot project to estimate resources for all-sky mosaic

Spitzer IRAC Image Mosaics

- SWIRE mosaics
- In mission planning, Montage used to build sky simulations in mission planning
- Fast background rectification and co-addition of in-flight images

Part of a 2.5 GB IRAC image near the Tadpole Nebula