Vision Workbench & Ames Stereo Pipeline

Zachary Moratto, Intelligent Robotics Group NASA Ames

ASRL Virtual Meeting May 3rd 2011
There are many and you can probably can name a few.
Vision Workbench

- We’re NASA Open Source Licensed.
- We do lazy image operations that rasterize only on writes.

```cpp
ImageViewRef<uint8> lazy = (image2 + 5)/image1;
write_image("clear.png", lazy);
write_image("blurry.tif", gaussian_filter(lazy,1.4));
```
DiskImageView<PixelT>("input.jpg")

atan2(derivative_filter(original,1,0), derivative_filter(original,0,1))

gaussian_filter(original,3.0)

rotate(original,2/*rad*/, Vector2(300,200))
Ames Stereo Pipeline

• We address Planetary Science’s demand for 3D models from orbital imagery.

• You’ve seen this before from:

• However, we’re free and NASA Open Source Licensed to help Science do more science.

Ames Stereo Pipeline result from LRO-NAC, Jackson Crater
Ames Stereo Pipeline

- Users provide images and camera models. Stereo Pipeline returns the point cloud.
- We also provide tools for conversion to Geo-TIFF or KML Tree.

Intermediate images from Ames Stereo Pipeline ran on Apollo 15 data.
Ames Stereo Pipeline

- We are able to support so many NASA & ESA missions because we utilize USGS’s Integrated Software for Imagers and Spectrometers (ISIS).

[isis.astrogeology.usgs.gov](http://isis.astrogeology.usgs.gov)

Example of ISIS map-projecting MOC imagery from Mars Global Surveyor.
• We can also run consumer cameras. User’s camera calibration is key, but we support formats like TSAI, CAHV, CAHVOR, and CAHVORE.

• We are not ideal for real-time stereo. Still novelty for small images.
Vision Workbench and Ames Stereo Pipeline are available on 
Bundle Adjustment

- We’ve been combining Vision Workbench and Stereo Pipeline to work on a large project that extracts 3D maps from orbital Apollo Imagery.
Bundle Adjustment

• We must solve for the pose of 4,010 cameras that have varying illumination in an environment with non-lambertian surfaces.

• Our problem is gathering measurements and then robustly solving for their locations.

Apollo 15 Metric images of Timocharis, Feuillee, and Beer crater.
• Others’ work, like Snavely and Dellaert, tackle two extremes of BA.

• Our data is in the middle and I haven’t decided the best approach.

• Our code will probably not scale past 5000 cameras with Apollo like survey.

Picture from Dellart’s “Out of Core Bundle Adjustment”. Dellart handles very sparse problems and values partitioning to get fast results. Snavely handles very dense datasets where partition does not seem economical. Instead he values mixed sparse/dense algorithms.
Contact:

z.m.moratto@nasa.gov

Ames Stereo Pipeline result from MER-1 Navcam