Hawkeye: Deciphering textural clues remotely

Summary

• Hawkeye can decipher grain-scale textural clues to geologic or biologic history, from a distance.
• Wide field of view and focus to infinity enable panoramic imaging to place grain-scale observations in regional and local context.
• The broad range of distances over which Hawkeye yields useful images makes it a very cost-effective all-in-one imager that supports science and operations efficiency.
Science background

- Lithologic features involving grains and grain relationships (0.5-10 mm in scale) provide key (sometimes decisive) indicators of rock-forming environments.
What is the need

- Resolution at this scale is currently possible, but images are expensive to acquire resource-wise.
What is the need

• Most environments are both laterally and vertically variable at this scale; coverage is key to interpretation.

• Specifically for biosignatures, colonies are predicted to be small and spatially isolated, again necessitating coverage.

• Without sufficient textural data, lithologic clues may be interpreted incorrectly, wasting time and spacecraft resources.
• Mastcam/Pancam/SSI-type images to capture morphology
• Both regions are “off-traverse”

CRISM pixel = amorphous silica, calcite
Surface clasts, possibly from upper layer
Resolved wavy lamination = microbial mats
Design

• Focal plane assembly and electronics — build-to-print copy of flight MSL Mastcam
• 1600 x 1200 pixels
• Bayer-pattern RGB
• All-refractive design consisting of one moving focus group and a single front stationary group.
• Focal length 370 mm, focal ratio of f/10, focusable closer than 2 m.
Design

- Integral heater to warm mechanism for operation if needed.
- Can operate -40°C to +60°C and qualified to survive > two Earth years of diurnal temperature cycles (down to -135°C) without heating.
Performance and use

Mastcam Left (34 mm) image of the Bardin Bluffs outcrop from ~ 5 m distance; Pixel Scale ~1.1 mm/pixel.

MAHLI image of the Bardin Bluffs outcrop from ~25 cm distance; simulates Hawkeye best resolution; Pixel Scale ~0.1 mm/pixel.
Performance and use

Simulated Hawkeye view:
Image at infinity focus
Closest objects are m away; distant feature is km away

MSL MAHLI image 1072MH00032500504000731E01
Performance and use

Simulated Hawkeye panorama:
Mosaic of 65 images acquired at infinity focus
Summary

• The Hawkeye camera can decipher grain-scale textural clues to geologic or biologic history, from a distance.
• Wide field of view and focus to infinity enable panoramic imaging to place grain-scale observations in regional and local context.
• The broad range of distances over which Hawkeye yields useful images makes it a very cost-effective all-in-one imager that supports science and operations efficiency.
Summary

- Abundant grain-scale data for context & diversity
- Optimized sample science
- Low operational overhead & high heritage

Hawkeye
Backup slides
How Hawkeye meets the need

- Habitability potential? Not at the grain-scale.
- Images could be acquired in 6-8 minutes.