Performance of New Low Cost 1/3" Security Cameras for Meteor Surveillance

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Hypothesis

- It's been almost 5 years since the CAMS systems were spec'd
- The latest models of low cost security cameras based on 1/3" sensors might now be sensitive enough to perform for CAMS
- Given the smaller sensor, full-sky coverage may be obtained by using different focal length lenses depending on elevation angle
- Is the resolution good enough for CAMS?
- Spatial resolution for accurate meteor surveillance at the target 4 arcmin/pixel or smaller
- Is the FOV large enough to build an all-sky array using 16 cameras?

1/3" f/1.2 Fixed Iris IR Lens Set

- \$8 each 1/3" lens performed better than the Pentax 12mm f/1.2 (IR focuses along with visual spectrum)
- For Single-CAMS, recommend purchase one set for each camera
- For an array, purchase extra lenses of different focal lengths
- If you can get some f/0.75 f/-0.95, you'll get improved results (though most have coma issues)

Be sure to get IR compatible





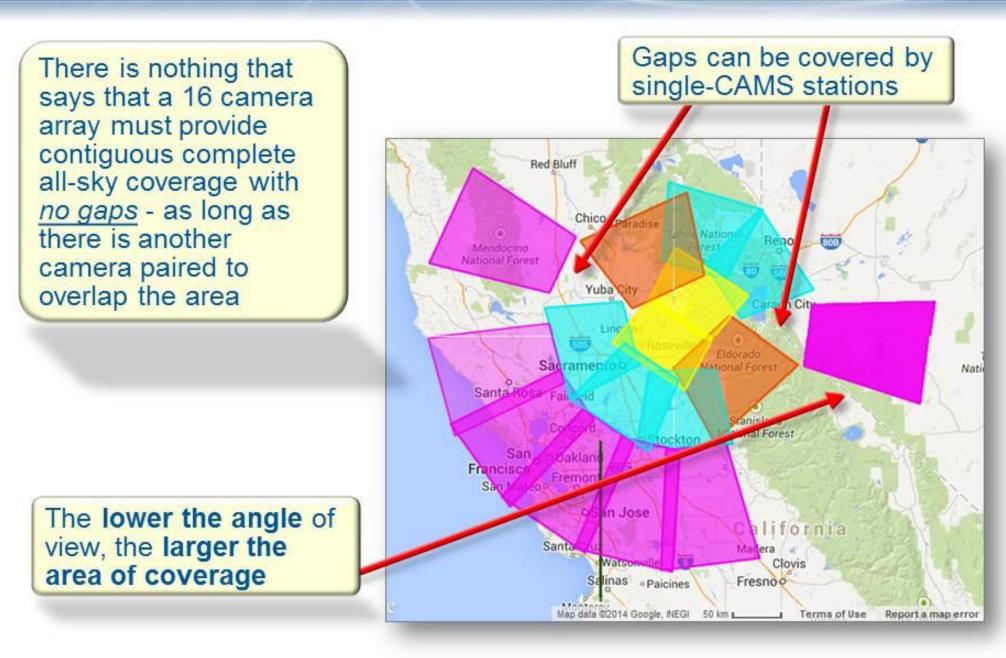


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It's a good idea to use DC auto-iris lenses for cameras facing the sun. Available for under \$40

Low Cost 1/3" Cameras for Meteor Surveillance

Area of Coverage

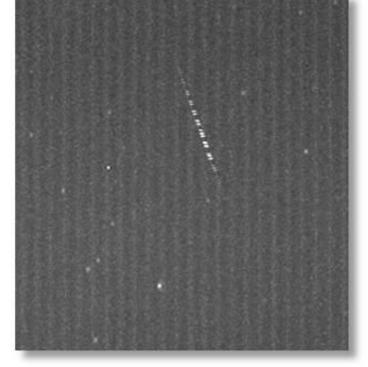


Low Cost 1/3" Cameras for Meteor Surveillance

Frame Rate (Strobing)

- Care must be taken to adjust the settings to prevent the camera from going into Sens-Up or Night Mode
- In these settings, we found that the frame rate dropped to 1/30 or $1/15 \sec$
- It's important to use interlaced capture





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Low Cost 1/3" Cameras for Meteor Surveillance

New 1/3" Cameras

Sony Super HAD II 960H based

| Sensor | or 1/3" 960H High Sensitivity CCD | | |
|----------------------|---|--|--|
| Resolution | 700 TVL | | |
| Minimum Illumination | 0.003 lux 30 IRE Normal shutter f/1.2/AGC | | |
| S/N Ratio | > 50 dB (AGC OFF) | | |
| Pixels | 976 x 494 NTSC (976 x 582 PAL) | | |



Sony ExView HAD II 960H based

1/3" 960H High Sensitivity CCD 700 TVL Resolution 0.003 lux 30 IRE Normal shutter f/1.2/AGC Minimum Illumination > 50 dB (AGC OFF) S/N Ratio 976 x 494 NTSC (976 x 582 PAL) Pixels

- \$56 LN-300-9H672
- On-Screen Display (OSD) Menu
- Provides objective settings





Care must be taken to get cameras based on the right sensor and matched with the right DSP firmware

Two 16 Camera Arrays Tuned for Max Coverage Overlap

· Near full-sky coverage can be obtained from just two sites for around \$4,400 total

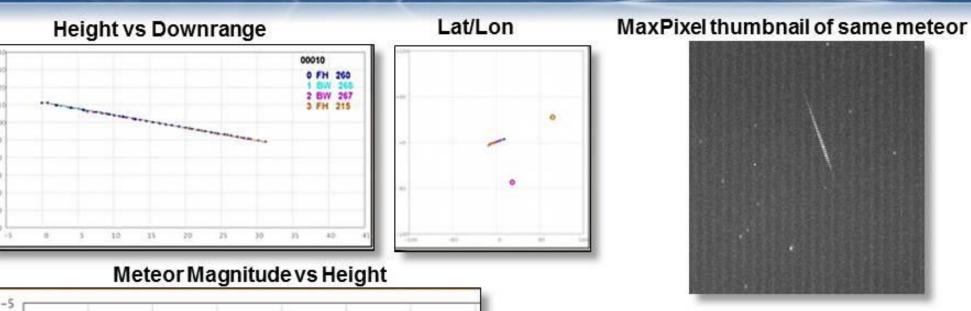


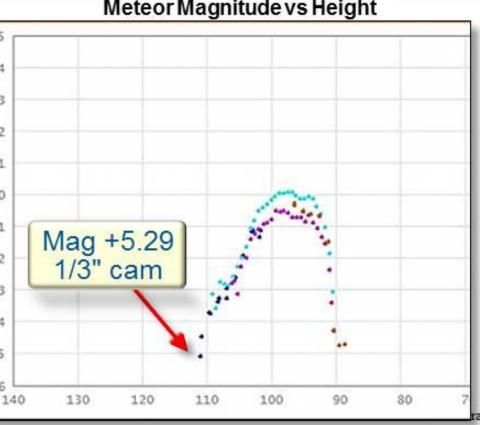
| YTÇ | Description | Unit Cost |
|-----|----------------------|-----------|
| 32 | Cam + Lens | \$60 |
| 2 | Intel i7 Computers | \$700 |
| 1 | 8 Channel Grabbers | \$190 |
| 2 | 16 port power supply | \$40 |
| 2 | Housings | \$300 |
| 2 | Wiring | \$200 |

Coming soon - Support for dual 8 channel Sensoray grabbers for a total of 16 cameras at once

Limiting Magnitude

Low Cost 1/3" Cameras for Meteor Surveillance



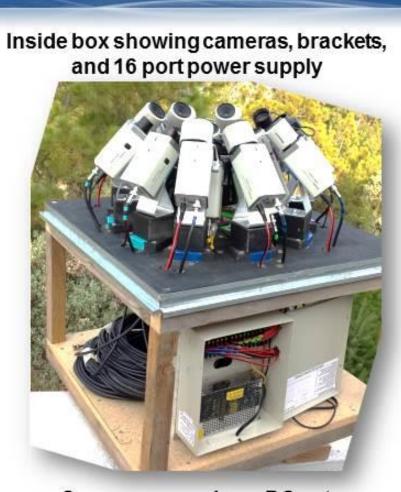


| Mean | 0-C = | 0.595 +- | 0.282 | arcmin | |
|------|-------|----------|-------|--------|------------|
| Star | v | B-A | R | IR | O-C arcmin |
| | | | | | |
| 52 | | | | 6.34 | 1.018 |
| 53 | 7.15 | 1.10 | 6.51 | 5.91 | 0.871 |
| 54 | 7.17 | 1.01 | 6.58 | 6.02 | 0.882 |
| 5.5 | 7.22 | 1.04 | 6.62 | 6.04 | 1.159 |
| 56 | 7.16 | 0.57 | 6.82 | 6.49 | 0.644 |
| 57 | 7.22 | 0.17 | 7.10 | 6.98 | 0.922 |
| 58 | 7.41 | 0.54 | 7.09 | 6.77 | 0.671 |
| 59 | 7.63 | 0.60 | 7.27 | 6.93 | 0.796 |
| 60 | 7.78 | 0.90 | 7.26 | 6.75 | 0.778 |
| 61 | 7.84 | 0.10 | 7.76 | 7.68 | 0.614 |

Jim Wray's 18 Camera All-Sky 1/3" Array







Some cameras have DC autoiris and some do not

Over 1,000 orbits contributed by these 1/3" cameras from May 17, 2014 to September 8, 2014

With just 2 cameras!

Low Cost 1/3" Cameras for Meteor Surveillance

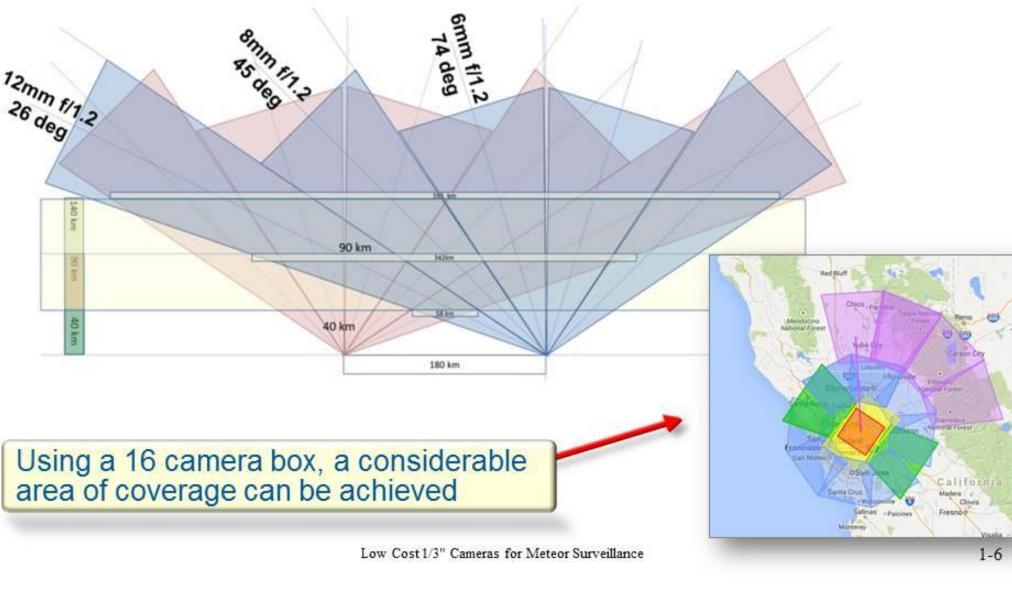
Remove the IR-cut Filter

- The IR-cut filter dropped the sensitivity by about 1 magnitude
- Not difficult to remove on the 100H
- 16 cameras in the test had to have IR cut filter removed
- When ordered without it, the vendor shipped the 17th camera without the filter as requested - check with your vendors
- The EQ700 camera tested had a motor that moves the IR-cut filter in night mode



All-Sky Coverage

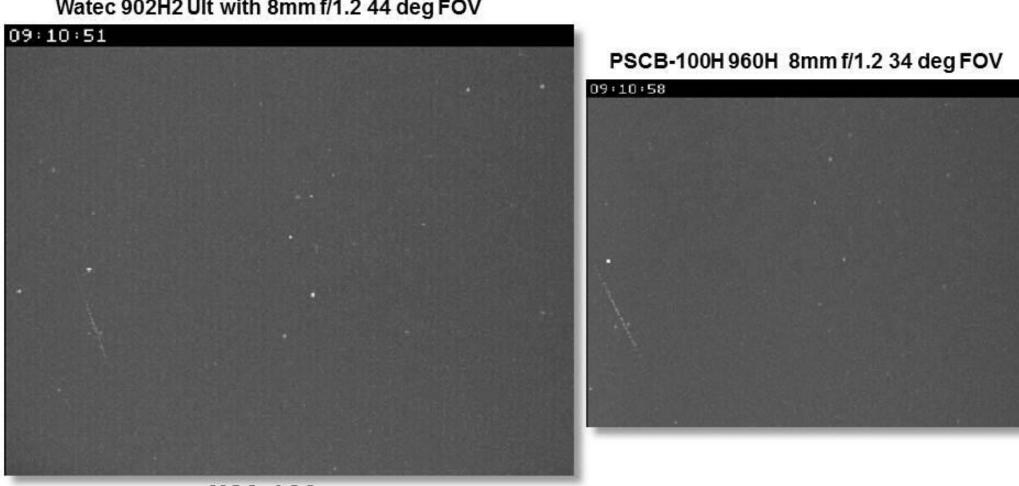
• Tuning the focal length to match the elevation angle, two 16 camera stations can achieve full sky coverage from 18 degrees to 90 degrees



100H vs Watec

- Same meteor, same lens, different cameras
- The Water represents the standard

Watec 902H2 Ult with 8mm f/1.2 44 deg FOV



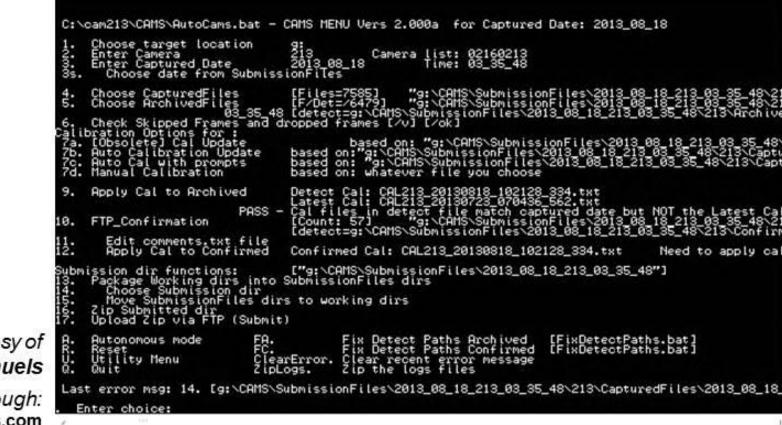
MGC=AGC

Images untouched other than equal amount of brightening for the poster

Use AutoCAMS for Autonomous Operation

- AutoCAMS is a script-based wrapper around the single-CAMS software
- Facilitates the use of the programs and utilities
- User-configurable to achieve full autonomous operation for months (until you run out of disk space)

AutoCAMS Main Menu



AutoCAMS courtesy of Dave Samuels seticams@yahoops.com