Recording meteors with low-light video cameras

I have been an active meteor observer for many years and have had some success in photographing meteors with 35mm and medium format cameras. The major annual meteor showers can produce significant numbers of naked-eye meteors and some of these can be captured on videotape by using relatively simple equipment. I was impressed with Andrew Elliott's results using low-light video cameras and image intensifiers, so in 1996 I decided to purchase a video camera for meteor videography.

Video cameras

I bought an AstroVid 505E monochrome video camera with a C-mount 12mm f/1.2 lens. This combination is rated at 0.01 lux. Its ½-inch format chip (6.4×4.8mm) gives a field of view some 29° by 22° and a stellar limiting magnitude of 4 on the TV monitor. The AstroVid's electronic shutter operates at speeds from 1/25th second to 1/10,000th second and this can be adjusted manually. I set it to 1/25th second for meteor work. The camera records meteors down to 3rd magnitude. The silica window of the camera's chip is kept relatively dust free by the use of a blower brush and the occasional delicate application of an isopropanol wipe.

Since 1999 I have also used a Hi8 Sony TR3200E camcorder, which was very successful in recording the 1999 Leonids meteor storm as seen from Cyprus. (JBAA, **110**(5), 232 (2000)) The camcorder is rated at 0.1 lux when operated at f/1.6 and 1/3 second shutter speed, which records 6th magnitude stars at ×20 optical zoom. For meteor work the camcorder's electronic shutter is set to 1/3 second, the lens to f/1.6, the zoom setting to give a 'normal' field of view and the gain is adjusted to as high a setting as possible without introducing excessive electronic 'noise'. (Be wary of 'zero lux' camcorders. These take images in the dark but they achieve it by implementing an infrared beam which illuminates subjects up to a few metres away.)

In addition I have a 1/3-inch format (4.8×3.6mm) Maplin monochrome video camera which is rated at 0.02 lux.

Figure 1. A Geminid meteor passing Orion, recorded on the night of 1997 December 13/14, with the Full Moon only 30° away.

Video recording

The camera is mounted on a driven equatorial head and is centred on a field of bright stars, generally 30° away from the meteor radiant. Alignment, focusing and monitoring are done on a 12.5cm monochrome monitor. The camera is also sometimes operated on a static tripod. The output signal from the AstroVid camera is fed into a time-and-date inserter unit and the composite image is captured on a standard VHS video recorder. Long play mode is avoided because it causes degradation of the images. Tape copies also result in a further reduction in image quality.

The time-and-date inserter is not linked electronically with radio time signals and has to be synchronised manually with an MSF radio-controlled clock. The time-and-date feature on the camcorder is also synchronised manually.

The mono video camera and time-and-date inserter require a 12 volt DC power supply, which is provided by a portable 'power station'; a sealed lead-acid battery pack. The video recorder and monitor are 240 volt mains devices and are kept indoors, protected by a residual current circuit breaker. Meteor observing often takes place during cold damp nights so please consider electrical safety at all times. Let's be careful out there!

Videotape analysis

Analysing the tapes is a laborious manual procedure and requires patience. This is performed in a darkened room, with the video monitor set to maximum contrast, minimum colour and the brightness adjusted to personal taste. The tape is played and the time of each meteor (if any) is noted. Fatigue soon sets in so it is recommended that these sessions are limited to 20 or 30 minutes in duration. At least three complete passes through the tape are required to note all events.

Image processing

To process the images the videotape is played through a PC and graphics card. A video sequence encompassing the duration of the meteor is captured at 25 frames per second and this is saved to an AVI file and processed by Animation Shop. Individual frames are saved and then merged into one composite image within Paint Shop Pro. Meteors are generally only visible for less than 1 second, so most are visible on no more than 15 frames. An interesting effect is that with the video frames being recorded every 1/25 second it is possible to create a composite image which looks as if a rotating shutter has been used.

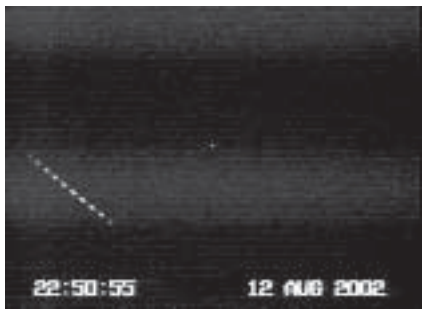

Figure 2. A Perseid meteor near the star ε Pegasi, showing the time and date recording feature.

Applications

Accurate video timings of meteors can be combined with astrometry from photographic stations to determine the shower radiant.

Meteor shower activity can be monitored from light-polluted sites, during twilight and moonlight and through partly cloudy skies.

The magnitude distribution of brighter meteors can be estimated and compared with the results of visual observers.

Motion sequences and single/composite frames of bright meteors can be used to illustrate lectures and to promote interest in their study.

Video should be used to complement – not to replace – other methods of meteor observation.

In recent years my enjoyment of visual meteor observing and meteor photography has been severely hampered by my neighbours' 'insecurity' lighting. Video has helped me to continue to monitor the major showers from my garden in Leeds. I have successfully recorded Quadrantid, Perseid, Orionid, Taurid, Leonid, Geminid and sporadic meteors and it is fascinating to note the different velocities of the meteors.

Len Entwisle also runs a video camera system from Elland, West Yorkshire and we aim to do two-station meteor videography. Our climate is hindering this project!

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