AUTOMATED HIGH DEFINITION AND HIGH SENSITIVITY CMOS SYSTEMS FOR METEOR SCIENCE IN THE FRAMEWORK OF THE SMART PROJECT. J. Segura[1] and J.M. Madiedo[1]. [1]Facultad de Ciencias Experimentales, Universidad de Huelva, 21071 Huelva, Spain.

Introduction: Different technologies have been traditionally employed to obtain images of meteors produced when meteoroids interact with the Earth's atmosphere. The first of them is analogue photography, which employed black and white fast films to increase the sensitivity of the recording camera. Over one decade ago, these cameras were replaced by high-sensitivity devices employing black and white CCD sensors. These cameras were employed, for instance, in the framework of the SMART project (Spectroscopy of Meteoroids in the Atmosphere by means of Robotic Technologies), which is being conducted by the University of Huelva. These included CCD video cameras, which demonstrated to be also suitable for meteor spectroscopy [see e.g. 1-4 and references therein]. Since 2012, with the improvement of CMOS technology, we have renewed some of the instruments operating at the meteor-observing stations of the SMART project. This new instrumentation includes different high-definition and high-sensitivity CMOS cameras. Some of these devices also employ color sensors and have shown to be very efficient to monitor the night sky. We give here a preliminary description of these new systems.

Figure 1. One of the high-definition and high-sensitivity color CMOS cameras (Sony A7SII) integrated in the automated mobile meteor-observing station.

Automated color CMOS video stations: The new cameras setup in the framework of the SMART project employ high-sensitivity CMOS sensors, and most of them obtain color images of meteors. These include Sony A7SII cameras, which can obtain high resolution videos (up to 4K) operating at 50 frames per second (fps), and also 14-bit ASI185MC cameras, which provide a maximum resolution of 1944x1224 pixels and can operate at 108 fps. Both of these cameras significantly increase the spatial and temporal resolution, and also the sensitivity, of some of our previous systems based on 8-bit black and white CCD video devices.

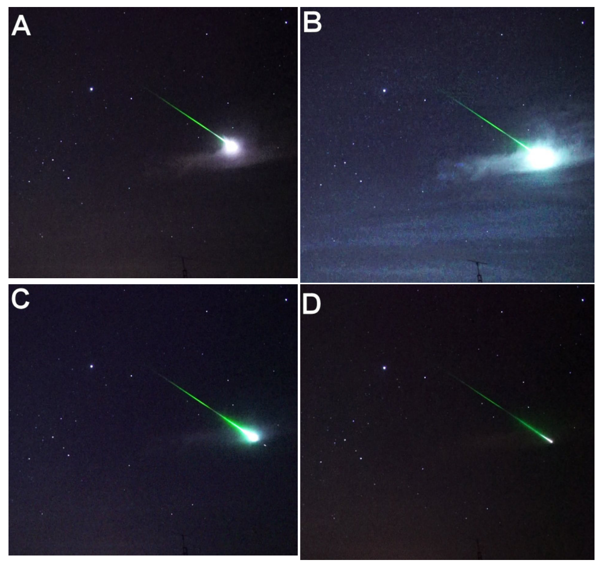

Figure 2. Four individual frames extracted from the HD color video recording of a Leonid fireball spotted on 2017 Nov. 18 at 3:35:48UT from the automated SMART mobile meteor station deployed at La Hita Astronomical Observatory.

Since these devices are not specifically designed for astronomical projects, the Sony cameras have very important drawbacks that had to be addressed in order to employ them as autonomous meteor-recording systems operating in video mode during the whole night. These issues were solved by means of hardware and software developed by J.M. Madiedo in the framework of SMART. In this way, it is possible to automatically identify meteor trails in real time in the images recorded by them. Currently, these Sony devices are employed in the meteor-observing station operating at Sevilla (Spain). But also an automatic mobile meteor station has been designed with 5 of these cameras (Figure 1). This mobile station has been employed for specific meteor-monitoring campaigns conducted at several observatories in Spain. Figure 2 shows an example of a Leonid fireball spotted by this mobile station operating at La Hita Astronomical Observatory (Toledo, Spain) on 2017 Nov. 18.

Figure 3. Automated high-definition and high-sensitivity color CMOS camera deployed at La Hita Astronomical Observatory.

Figure 4. Sum-pixel image of a Geminid fireball recorded on 2018 Dec. 14 at 3:30:55 UT by an automated high-definition and high-sensitivity color CMOS camera deployed at La Hita Astronomical Observatory.

The ASI185MC cameras have been deployed at two fixed SMART stations: La Hita and Sevilla (Figure 3). These cameras operate as autonomous meteor systems also by means of software developed in the framework of SMART. As an example, Figure 4 shows the sum-pixel image of a Geminid fireball recorded by one of these devices from La Hita Astronomical Observatory on 2018 Dec. 14, at 3:30:55 UT.

As our previous automated systems do, once the observing session is over, the images recorded by these CMOS cameras are automatically compressed and sent to an FTP server for further processing. Software running on this server checks the recordings from the different stations and identifies which meteor trails have been simultaneously recorded from at least two different locations [1, 3].

Conclusions: The SMART project is employing since 2012 automated meteor recording systems based on high-sensitivity and high-resolution CMOS color devices. This significantly increases the spatial and temporal resolution, and also the sensitivity, of some of our previous systems based on 8-bit black and white CCD video cameras. Hardware and software have been developed to operate these new meteor cameras in an autonomous way. The new devices have been setup in fixed and mobile meteor-observing stations, and they will be also installed at other SMART meteor stations in a near future.

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