Mobile Observation of Meteors (MoMET): a device dedicated to meteor shower outburst

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The MoMET project aims to observe meteor shower outbursts by setting up two mobile stations. In order to make the most of such endeavour, two suitcases were developed, each containing 2 wide FOV cameras for ZHR determination, and 3 narrow FOV cameras for orbit measurement and spectroscopy. The RMS software for acquisition and detection was installed on Odroid XU4Q mini-computers running Ubuntu. A user interface allows to control each camera and a GPS to set the time and location.

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1 The MoMET project

1.1 Introduction

The observation of recurrent meteor outbursts provide insights about their origin, age, parent body identification and behaviour (e.g. outgassing), composition and about their evolution in the Solar System (dynamics). Although wide spread meteor camera network survey a large surface of atmosphere (Devillepoix et al., 2020; Vida et al., 2021), the orbital geometry might not always allow the record of a specific outburst. One recent example is the new shower caused by comet 15P/Finlay (Ye et al., 2015; Vaubaillon et al., 2020), observable from South America where there is a limited number of meteor cameras (Tóth & Kaniansky, 2016). It is therefore very useful to deploy a mobile camera network on the ground to fully cover an exceptional event (e.g. Atreya & Christou, 2009; Vaubaillon et al., 2015). In addition, due to bad weather conditions, it is sometimes useful to change the observation site when it is not possible to operate from above the clouds (Rambaux et al., 2021). The "Mobile Observation of Meteor" (MoMET) project aims to easily deploy such a local and mobile network of cameras, in a timely and scientifically efficient way.

1.2 Scientific goals and means to achieve them

Optical observations of meteors allow to constrain the following properties :

- G.1 parent activity, meteoroid lifetime expectancy
- G.2 meteoroid formation
- G.3 meteoroid composition
- G.4 meteoroid tensile strength
- G.5 comet to asteroid link
- G.6 origin of meteoroid stream
- G.7 age of meteoroid stream

Scientific goals G.1 and G.2 are accessed with wide field of view (WFOV) cameras, by measuring the ZHR (Koschack & Rendtel, 1990). G.3 is accessible thanks to low resolution spectroscopy, implying a narrow field of view (NFOV) camera equipped with a grating. G.4, G.5, G.6 and G.7 necessitate a double-station setup, preferably with NFOV cameras for better accuracy.

In order to fulfill all these goals, the MoMET project involves two suitcases each containing 2 WFOV cameras, and 3 NFOV cameras, one of which is equipped with a 600 l/mm grating. The relative pointing directions of the suitcases (and – inside – of the cameras) are optimized to observe the widest atmosphere area given the scientific constraints.

2 Development

2.1 Hardware

A MoMET suitcase is equipped with IMX174-based cameras (either Basler acA1920-55um or DMK 33UX174), with 6- or 12-mm lenses (for WFOV and NFOV respectively). The control mini-computers are either Odroid XU4Q or RaspBerry-pi 4. An ethernet switch connects all the cameras to the same network. The user takes control of the cameras through the mentioned switch. A mechanical structure was designed and built, that allows the folding and unfolding of the cameras. The electrical power is ensured either from power outlet or from a car battery. In the latter case, we estimate the observation can run for about 8 hrs with a full battery. A GPS antenna provides time and location. Figure 1 shows one MoMet suitcase.

2.2 Software

The acquisition and meteor detection is ensured by the RMS software (Vida et al., 2016; Vida et al., 2021). In order to adapt RMS to Odroid mini-computers, a temporary SWAP memory was added. We use the Gstreamer[a] and Aravis[b] libraries to handle genicam-type cameras. One of the 5 mini-PC is equipped with a

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[a]`https://gstreamer.freedesktop.org/documentation/video`
[b]`https://github.com/AravisProject/aravis`

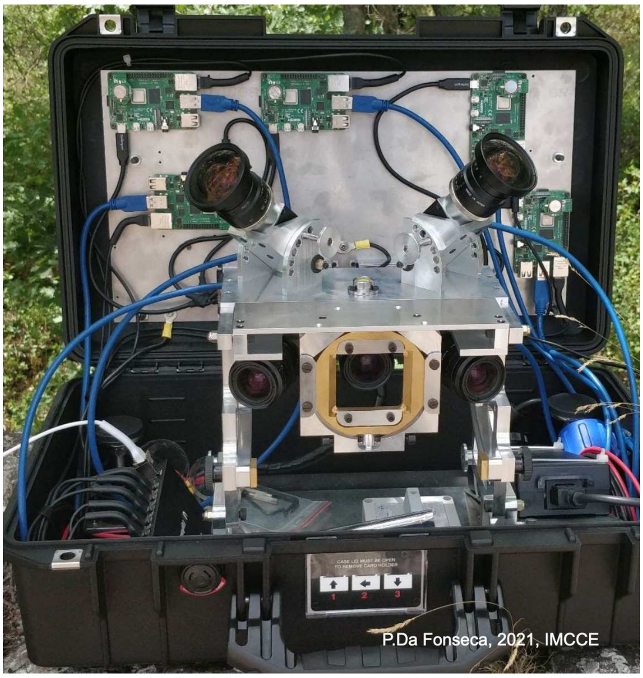

Figure 1 – Deployed MoMET suitcase (P. Da Fonseca, IMCCE).

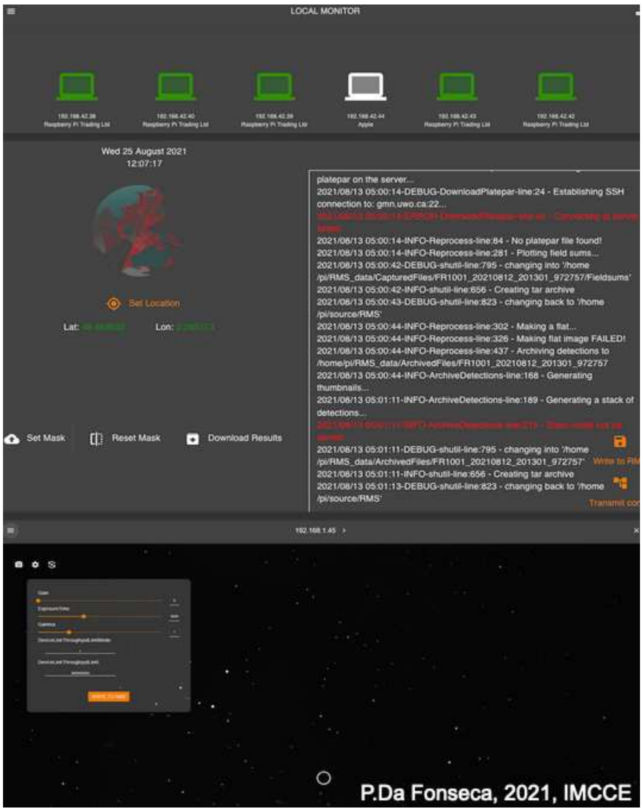

Figure 2 – Screenshot of the The MoMET GUI in operation (P. Da Fonseca, IMCCE).

DHCP server, allowing the user to take control of each camera, set the RMS parameters, get a live view of the camera (for pointing, focusing and demasking purposes) and set the time with a ms precision (XBU-353). Figure 2 shows the MoMET GUI.

3 Conclusion

The "Mobile Observation of Meteors" was tested during several test campaigns. At the time this paper is written, the 2 MoMET cases are in Chile for the record of the new meteor shower caused by comet 15P/Finlay, as predicted by Vaubaillon et al. (2020). Tutorials are available to learn how to operate the MoMET suitcase[c]. The software codes are freely available (upon request) on gitlab.

The astrometry will be performed using SkyFit2, from the RMS distribution. Meteoroid orbit calculations will be performed using either Vida et al. (2018) or Egal et al. (2017) methods.

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[c]https://www.youtube.com/playlist?list=PL5_hsURFgP_AbYmAVuokJqeTypMU1ltsd

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