Expeditions 2014 with AMOS cameras

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Slovak Video Meteor Network (SVMN) is a project of the Comenius University in Bratislava for continuous monitoring of meteor activity over Slovakia and surrounding countries. The network is based on AMOS (All-sky Meteor Orbit System) Cameras, which astrometric precision was calibrated using several commonly observed fireballs within the European Fireball Network. The cooperation with other national video meteor networks and amateur observers yielded to EDMOND video meteor database. The extension of the AMOS Cameras for the Canary Islands and Chile to cover the Southern hemisphere is planned. We present preliminary results of the expedition on Canary Islands (April 2014) and from Canada (Camelopardalids, May 2014).

1 Overview of the AMOS system

The system AMOS (Automatic Meteor Orbit System) consists of a fish-eye lens, an image intensifier, a projected lens and a digital video camera (Zigo et al., 2013). The field of view of the AMOS is 180° × 140° and the output digital resolution 1280 × 960 pixels with a video frame rate of 15 per second (the new version uses digital cameras with 1600 x 1200 pixels and 20 frames per second). The limiting sensitivity is comparable to the human eye (mag. +5,5 stellar objects, mag. +4 for moving objects). The operation of the cameras is semi-automatic and needs electric power (110-220/24 V) and an internet connection. The whole system is protected by an outer and inner housing and is monitored by sensors for temperature (inside, outside), rain and illumination of the sky (Figure 1). The Moon light does not make any problems for the observations, except brightening the sky background. The system is designed for meteor observation (Tóth et al., 2011a), but could also be used for meteorological, geophysical, aviation or satellite observations as well. The inner part of the camera is portable (weight ~6.5 kg, size 50 × 25 cm) and suitable for surface expeditions or on board research planes (Vaubaillon et al., 2013; Koten et al., 2014).

2 Observations

The first prototype has been working at the AGO Modra Observatory since 2007. The AMOS cameras systematically monitor meteor activity in the Slovak Video Meteor Network (SVMN) at four locations at present, AGO Modra, Arborétum T. Mlyňany, Kysucké Nové Mesto Observatory and Važec stations with distances in the range of 80 – 150 km from each other. More stations are planned to be built in central and the eastern part of Slovakia. Each AMOS camera records about 10 000 meteors per year as well as about 50 transient luminous events (sprites, elves) under Central European sky conditions.

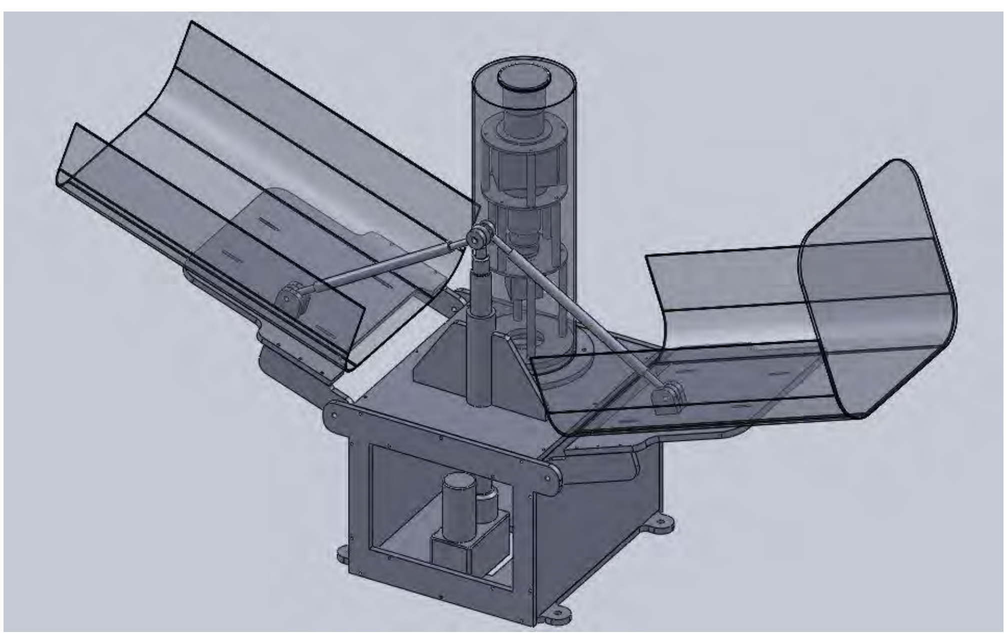

Figure 1 – AMOS camera with opened outer housing.

Figure 2 – Observing team at OT: J.Tóth, J. Világi, L. Kornoš and P. Zigo.

The standard astrometric error is within an interval of 0.03 – 0.05 degree resulting into several tens or a few hundreds of meters for the atmospheric trajectory determination of meteors. The internal precision of the AMOS cameras is even better, especially when the precise all-sky reduction described in (Ceplecha, 1987; Borovička, 1995) is used with our own trajectory software MT v.085.

The current version of the orbital dataset of video meteors recorded by SVMN (2009-2013) stations contains about 3000 orbits. The results from the observational expedition on Tenerife and La Palma (Canary Islands 2014) showed more than 4 times higher efficiency of AMOS cameras at high altitudes and dark sites compared to the networks of the same cameras at Central Europe weather and sky conditions (Table 1).

Canary Islands, April 2014

The motivation for a one week observing expedition at the Canary Islands observatories of IAC, *Obsevatorio del Teide (OT)* (Figure 2) and *Observatorio del Roque de los Muchachos (ORM)* was the following:

- To test the Canary Islands observatories sites for future permanent AMOS stations;
- To test the efficiency of the AMOS cams in excellent observing conditions;
- To confirm the potential/predicted meteor shower of asteroidal origin with the orbits of the Příbram and Neuschwanstein meteorites (Spurný et al, 2003; Tóth et al., 2011b; Koten et al., 2014).

We observed 7 nights ($\lambda_{\odot}$ = 12°.8 – 19°.1) by two AMOS all-sky intensified digital video cameras. The first and the last night we observed at the same site (OT) while 5 nights from April 3–7 we performed double - station observations between ORM and OT, 144.8 km away from each other. All together, the cameras recorded 680 meteors of which 516 meteors were recorded during double -station observations (Figure 3).

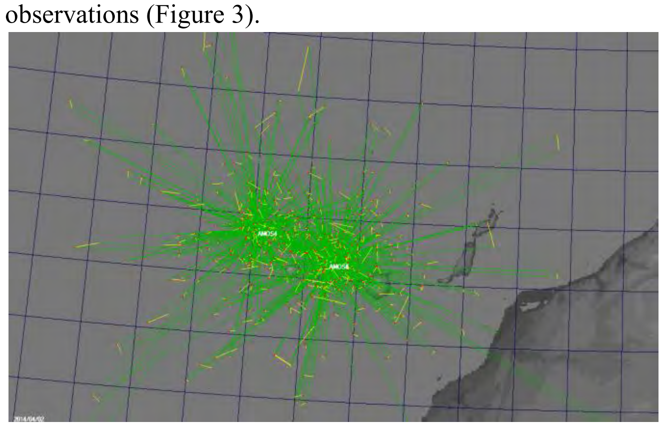

Figure 3 – Observed meteors by AMOS cameras from La Palma and Tenerife.

Only about 20% of them were simultaneously recorded. The magnitude range of the recorded meteors was from –3 to +4 with the peak between 0 – (+2) magnitudes. Overall meteor activity was weak for both, sporadic and shower meteors, typical for that part of the year. The ratio of sporadic and shower meteors was about 1:1. We recognized activity of 11 meteor showers, one established shower (027 KSE) and 10 from the working list. The average sporadic activity reached about 3 HR and showers average activity was as follows:

(049 LVI), (509 KVI) ~ 0.3 HR
(043 ZSE), (136 SLE), (131 DAL), (517 ALO) ~ 0.2 HR
(124 SVI), (123 NVI) ~0.1 HR
(027 KSE) ~ 0.1 HR
(272 ACO), (448 AAL) ~ 0.1 HR

We were most of all interested in the ACO shower, which has similar characteristics to our modeled potential meteor stream with the orbit of the meteorites Příbram and Neuschwanstein (Tóth et al., 2011). We identified 15 single station meteors from both cameras, which have angular velocities and backward prolongated direction to the radiant area of the ACO shower (Figure 4), of which 5 orbits are close to the orbit of the Příbram meteorite. But further investigation is needed for more conclusive results.

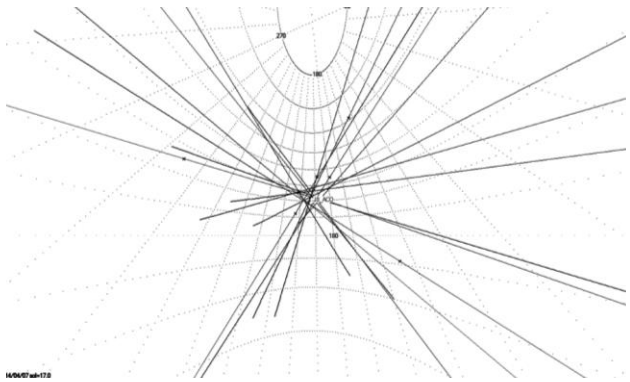

Figure 4 – Radiant positions of 15 ACO meteors.

Table 1 – Number of observed meteors by the AMOS cameras at the Canary Islands (La Palma, Tenerife) observatories and in the Slovak Video Meteor Network (SVMN) April 2 – 8, 2014.

2014 April	LaPalma AMOS4	Tenerife AMOS5	Slovakia AGO	Slovakia ARBO	Slovakia KNM	Slovakia VAZEC
2	48	50	26	7	9	6
3	49	50	2	1	6	15
4	46	60	4	2	4	-
5	55	68	-	-	-	-
6	38	56	15	-	6	13
7	45	48	11	-	5	16
8	29	38	-	-	-	-
Σ	310	370	68	10	30	50
	100%	119%	22%	3%	10%	16%

Canada, May 2014 (CAM) – small outburst

The predicted activity of the new meteor shower – Camelopardalids turned into a low level meteor outburst. However, we set up the AMOS cameras for a double station experiment in Saskatchewan, Canada and obtained 5 orbits of this special meteor shower (Figure 5) to demonstrate the capability of the cameras, common meteors were captured simultaneously from a distance of 100 km in a cloudy sky with lightening conditions. According to our visual observations, the activity of the Camelopardalids was stable at a ZHR of 20 – 30 in the time interval 5^h-9^h UT, May 24, 2014.

3 Conclusion

Both observational expeditions with the AMOS cameras were successful, even though the results are not conclusive in the case of a possible Příbram meteor stream or the number of data were far below the expectations for the Camelopardalids meteor outburst.

Acknowledgment

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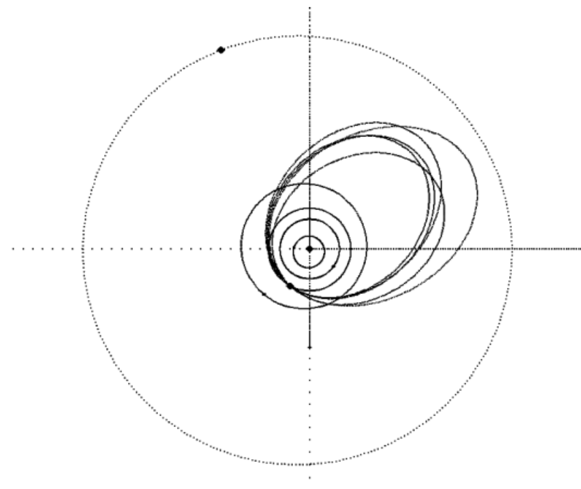

Figure 5 – Orbits (raw data) of Camelopardalid meteors simultaneously detected by AMOS-Cameras (May 24, 2014) from Grass land Park, Saskatchewan, Canada.

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