Efficiency and optimization of double-station and multi-station video observations of meteors

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Introduction

For simultaneous double-station video observations of meteors the problem is usually formulated as the registration of maximal possible amount of meteors (sometimes in determined range of their magnitudes) for the given meteor shower (or entire number of meteors including sporadic ones). At that one usually supposes that the precision of kinematical processing of meteors must be at least acceptable. The last requirement may be implemented only if the distance between observational points to be in some range conditioned by parameters of the optics, mainly by focal distance of the lens. Using wide-angle photographic lenses and assuming the meteors are emitting on height of 100 km the basic distance is varied, as a rule, in range 50-100 km (in our case 54 km) . Obviously, using telescopes for meteor observations the distance can be much shorter (a few kilometers, or even hundreds of meters).

Calculations

In the given work we consider, first of all, the problem of increasing efficiency of meteor registration on conditions that the distance between observational systems is preliminary selected. So that, we investigate the choice of orientations for optical axes of video or TV systems which are used for meteor observations, and compatibility of optical parameters of lenses. Fig. 1 demonstrates the scheme for calculation of common atmospheric volume controlled by both video cameras. Basic distance between points is R_{AB}, the intersection of optical axes is in point C, C_0 – projection of point C onto the ground. One can see the horizontal section of view fields of cameras at some height $C_Z < C$.

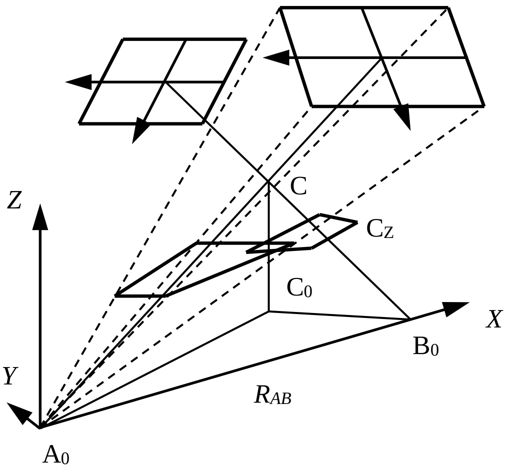

Fig. 1. Geometry of double-station observations: explanation to common atmospheric volume calculation

In the simplest case one can consider a set of lenses previously successfully used for meteor observations, in more detailed investigations one has to calculate the optical parameters and search for corresponding lenses. For our meteor observations we usually used photographic lenses of soviet production: Jupiter-3 ($F = 50$ mm, $F/1.5$, view field (with size of input photocathode in super-isocon TV system 3×4 cm) is $\approx 23.5^\circ \times 19^\circ$, angular pixel size is ≈ 4 arcmin. Limit star magnitude in clear night is $+9.0^m \div +9.5^m$), and Helios-40 ($F = 85$ mm, $F/1.5$, view field is $\approx 13^\circ \times 11^\circ$, angular pixel size is ≈ 2.2 arcmin. Limit magnitude is $+11.0^m \div +11.5^m$). For calculation of a spatial geometric zone of the common atmospheric volume we have developed according software. In the simplest case we can suppose all meteors are radiating on height of near 100 km, but we consider more complicated scheme where distribution of meteors is a function of height and magnitude. In addition, we were taking into account atmosphere absorption for low light level meteors.

Conclusions

The calculations were carried out for different orientations of optical axes for two mentioned lenses, and for some others. The difference in optimal registrations of shower and sporadic meteors was considered and according recommendations were done. The results obtained for double-station observations were used for optimization of multi-station observations and for calculations of an optimal plot of a network for meteor video observations. It was demonstrated that calculated geometric parameters can be used for solution of inverse problem, i.e. for determination of influx of space particles of different musses from continuous series of double-station and network observations of meteors.