PROJECT OF THE NETWORK FOR OCCULTATION PHENOMENA TELEVISION OBSERVATIONS

L. V. Kazantseva[1], **V. S. Kislyuk**[2], **V. V. Kleshchonok**[1]

[1] *Astronomical Observatory, National Taras Shevchenko University of Kyiv*
3 Observatorna Str., 04053 Kyiv, Ukraine
e-mail: likaz@observ.univ.kiev.ua

[2] *Main Astronomical Observatory, NAS of Ukraine*
27 Akademika Zabolotnoho Str., 03680 Kyiv, Ukraine

The project aimed at the equipment of observational stations of the existing network by the analogous television devices is proposed. Possibilities of a new observation program using the method of occultations for studying the kinematics of multiple star systems, Solar System small bodies, as well as figure of the marginal zone of the Moon are considered.

INTRODUCTION

Occultations of celestial objects are the most ancient phenomena, which can be observable from the Earth. Due to their simplicity, these observations are the most popular and regular. Over 400 years they have been carried out in 30 countries of the world; about ten thousand of the phenomena are annually registered. In spite of the development of new observation techniques, the interest to them remains till now. The range of problems solved by means of occultation observations is being extended.

The Astronomical Observatory of the Kyiv National University (AO KNU) during 40 years of coordination efforts on occultation observations has developed and now maintains a network of observational stations on the territory of the former USSR (Fig. 1). The Kyiv database of lunar occultations contains more than 25 000 results of observations, obtained by 500 observers at 80 stations. We have close contacts with the IOTA and ILOC centers and now this activity is being continued.

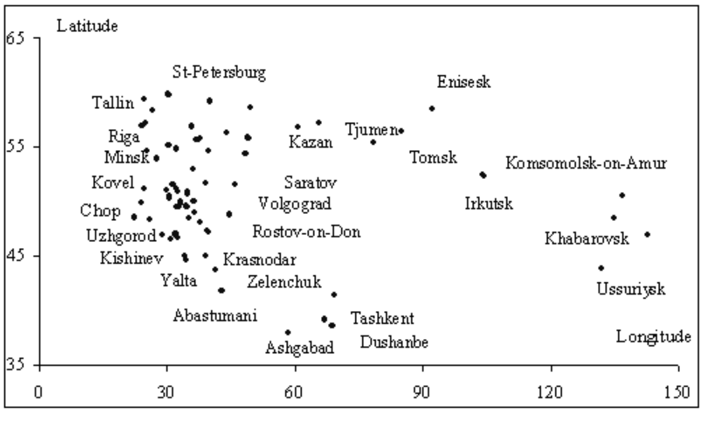

Figure 1. Network sites (1963–2004)

The new observation program by the use of the method of occultations gives possibilities for studying the kinematics of multiple star systems, Solar System small bodies, as well as figure of the marginal zone of the Moon. Accumulation of such precise observations from different points of the Earth will also allow us to avoid personal errors of observers and to receive the reliable information on the irregularity of the Earth's rotation and secular changes in the Moon's movement.

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THE NEW ASTRONOMICAL TELEVISION SYSTEM "SPALAKH"

Astronomers of AO KNU have a more than the 80 years experience in the observations of the occultations of stars by the Moon. Last year the new television system "Spalakh" was created at the observatory for observations of star occultations using a precise reference time. The time accuracy of the television system is equal to 50 ms, and limit star magnitude is equal to 12 mag for the Repsold refractor ($D = 20$ cm, $F = 4$ m). The software for recording TV signal together with time scale and for processing observations was created. A reference time accuracy of a fixation event time is equal to 10–15 ms. At present the television system is active used for occultation observations. "Spalakh" can work in expeditions and stationary conditions and has a number of advantages in comparison with other methods of observations (see for example Table 1).

Table 1. Approximate errors of measurements of the occultations of double stars

Measured Quantity	Technique		
	Visual	Photoelectric	Television
Limb Angular Velocity ($''$/s)	0.2 – 0.5	0.001	0.02
Timing (s)	± 0.2	± 0.002	<0.050
Magnitude difference (mag)	± 0.2	± 0.04	± 0.01
Magnitude range (mag)	~ 2	~ 3.5	~ 5
Limiting Angular Resolution ($''$)	0.05 ± 0.05	0.005 ± 0.002	0.01 ± 0.005

The "Spalakh" system includes the following components: television camera "Sanyo VCB-3574IRP", web-camera, GPS-receiver, computer with a frame grabber as well as software, which consist of the following programs:

1. VideoCap (for observation by means of the television system);
2. GPSwatch (for determination of system time using GPS-receiver);
3. OccultDark (for observation processing);
4. Tardis (for synchronization of computer system time in a local network).

The complex program includes:

- programs of predictions with the map, showing the location of the star at the moment of the occultation (total and grazing occultations of stars by the Moon, stars by asteroids, mutual eclipses and occultations of the major satellites of Jupiter, Saturn, and Uranus);
- software for observations with the television system "Spalakh";
- programs of reduction of occultation observations.

POSSIBILITIES FOR APPLICATIONS OF THE COMPLEX "SPALAKH"

The television complex "Spalakh" may be productively used not only for observations of lunar occultations but also for study the kinematics of multiple star systems and Solar System small bodies. Some of possible applications of the complex are summarized in Table 2.

CONCLUSION

Increasing accuracy of modern lunar ephemerides and star catalogues contributes to the improvement of observation methods and cooperation between observers. We hope that the proposed project on an international observational network, which involves stations with analogous television systems for observations, will be useful. By now, some institutions are agreed to take part in the project (see Table 3).

Table 2. Some possible applications of the complex “Spalakh”

Possible observations	Technique
Stellar occultations by planets and their satellites [1]	– information about the shape and structure of possible atmospheres of the occulting bodies – determination of the normal reflectance of satellites – analysis of ring systems – monitoring the freezing of the Pluto’s atmosphere due to the growth of the distance from the Sun and the resulting decreasing of energy budget at Pluto
Asteroidal occultations [2]	– more observers distributed across the paths provide determinations of asteroid shapes – possible observations of satellites of minor planets
Mutual Occultations and Eclipses of Satellites [3]	– very accurate astrometric measurements and several physical characteristics of the surfaces can be inferred from their observations – accurate astrometric positions for dynamical studies of motion of satellites
Double star occultations [4]	– discovery of new multiple systems – kinematics of multiple star systems

Table 3. Prospective Ukrainian Network of Television Observations of Occultations

No.	Partners	Station	Telescope	Objective Diameter, cm
1.	Astronomical Observatory of the National Taras Shevchenko University of Kyiv	Kyiv, Lisnyky	Refractor Merc–Repsold AZT-14 AZT-8	24 48 70
2.	Poltava Gravimetrical Observatory, NAS of Ukraine	Poltava	AVR-2	24
3.	Space Research Laboratory of the Uzhhorod National University	Uzhhorod	AVR-2	24
4.	Astronomical Observatory of the Odesa National University	Kryzhanivka, Mayaky	Schmidt Ritchey–Chretien	20 60
5.	Astronomical Institute of the Kharkiv National University	Kharkiv	Reflector AZT-7 Refractor	27 20 20
6.	Nikolaev Astronomical Observatory	Mykolaiv	Guide of zonal astrograph	11.5
7.	Main Astronomical Observatory, NAS of Ukraine	Kyiv, Golosiiv	Refractor	40

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