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01.01

4. Space Radiation Research Program In The USSR (U)
David O. Lintz (TDPTR)

This report is a review and evaluation of progress, trends and significant achievements in Soviet research in space radiation as reported during the past year.

Because of the time lag between research accomplishment data reporting and acquisition a minimum two year gap must be assumed in actual data reports. Only trends can be considered current.

A review of recent information on the biological effects of naturally occurring radiation indicate the following:

(1) The Soviets report continuing progress in radioprotective measures, dosimetry and solar flare weather predictions. However, no major achievement or breakthroughs were noted.

(2) Partial body shielding and whole body shielding are specific areas of continued interest and research activity.

(3) Soviet dosimetric methods now in use seems to be lagging, especially in the thermoluminescent dosimetry area.

However, the field of dosimetry is receiving most attention from Soviet scientists and progress should be impressive in the next few years.

Solar flare predictions are still limited from a few hours to a possible maximum of three days. Some Soviet-French workers are optimistic about accurate solar weather predictions within a very few years.

Space radiation, with solar flares being the primary contributing factor, is a continuing source of concern of the Soviets who are devoting considerable attention to the radiation environment and to developing methods of forecasting radiation weather or solar showers. Lack of internal communications and inadequate computer technology are problems of concern admitted by the Soviet workers.

Partial body shielding is still receiving consideration as a radiation protective measure. The Soviets report protective effects from shielding of the head greater than shielding of the upper or lower trunk. These findings are contrary to those obtained by United States researcher. Strong magnetic fields are still under investigation as a method of shielding by the USSR.

In the area of pharmacochemical protection and therapy, the Soviets have reported that "Amigdalin" (tablet form) given to dogs twice daily for three days protected against three times the lethal dose of radiation.

Lack of reliable dosimetric methods for space will prevent long duration (i.e. those flights in excess of thirty (30) days) manned deep space flights; therefore, continuous improvements on present dosimeters and new dosimetric methods are being sought by the Soviets. The Soviets are still using methods of radiation detection which have been abandoned by the United States. On the other hand, the Soviets have an instrument which they claim is capable of detecting and amplifying space radiation having a charge of as little as one billionth of a volt which can measure the radiation eruptions from the sun lasting but a few millionths of a second. Other than the above claims the Soviets have not had any dramatic breakthroughs in radiation detection, shielding or use of radioprotective drugs. (The overall classification of this item is ~~SECRET.~~) ~~(Gp3-Downgraded at 12 year intervals; not automatically declassified)~~ (NO FOREIGN DISSEM, except UK, Can, Aus, NZ, and NATO).

01.03

7. Soviet Capability for Real-Time Optical Tracking (U)
Lt E.B. Feinberg (TDPTR)

A new Soviet technique, presented at Cospar (Tokyo, May 1968), makes possible the real-time optical tracking of space probes. The paper (by P.P. Dobronravin, V.M. Mojzerin, V.K. Prokofiev, and N.S. Chernykh), "A New Method for Optical Tracking of Space Probes," describes the development of a proposal made by A.B. Severny.

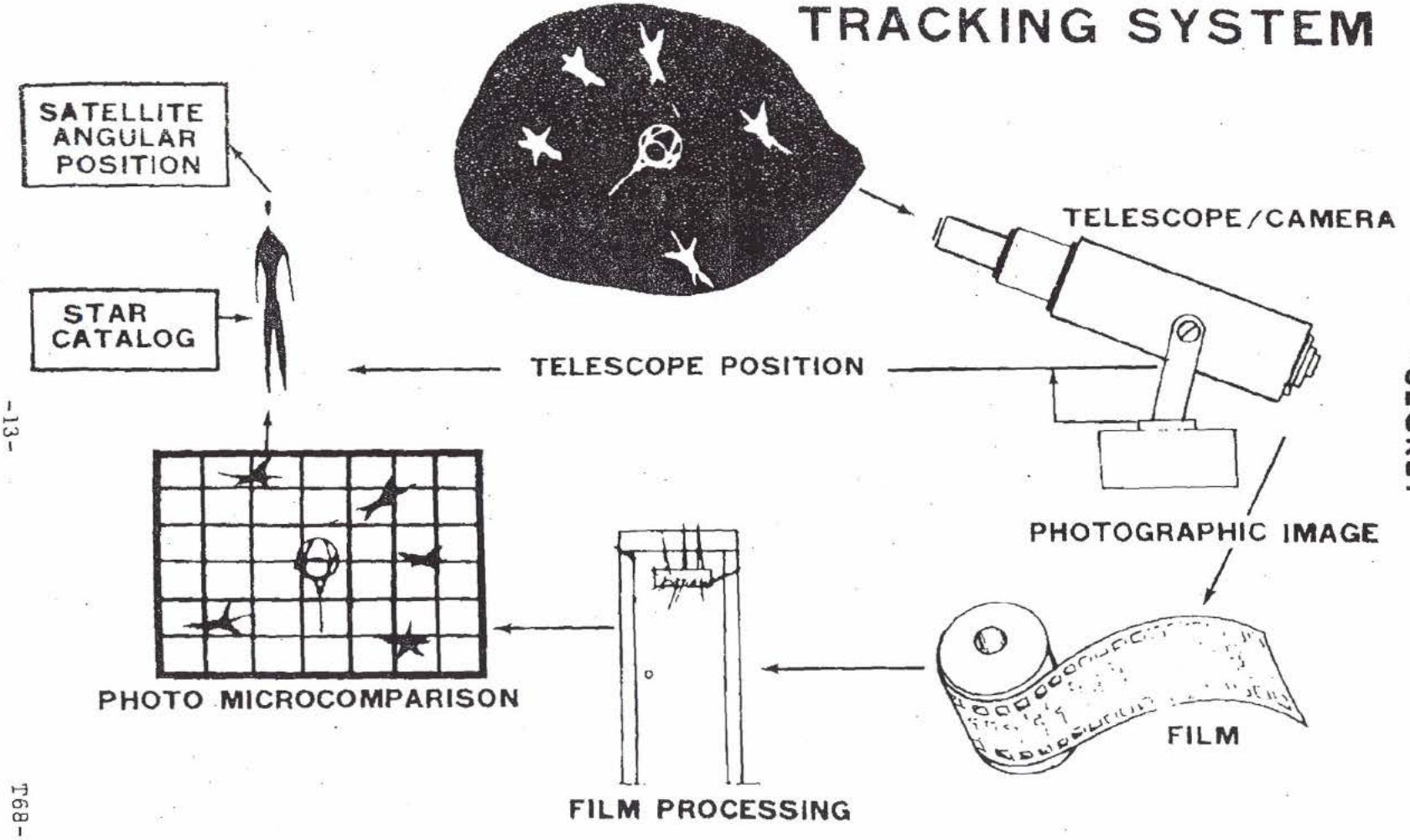
A TV system was attached to the 2.6 meter reflecting telescope located at the Crimean Astrophysical Observatory (44° 44'N, 34° 01'E). The space probe image is held on a cross-hair marked on the center of the TV screen. Time is obtained from a printing chronograph and the telescope position is obtained from the dial settings on the control panel. The positions of several reference stars are then used to correct the probe coordinates to a standard system of equinox 1950. The technique can obtain probe positions quickly, since it eliminates the time needed to process and measure photographic film, with an accuracy close to that of conventional methods.

The most serious problem in using such a tracking system is controlling telescope movements. The Soviets claim precise control over an angular velocity range of 1 to 10 arc-seconds per second of time, with an accuracy of 0.2 arc-seconds in right ascension and 2 arc-seconds in declination for position data read from the control panel dials.

To transfer from the topocentric coordinate system defined by the telescope to a standard system for a given equinox, the corrections between the two systems are obtained by observing several stars of known coordinates near the probe position on the celestial sphere. All corrections, whether connected with the telescope (bending, etc.) or with the system of coordinates (precession, aberration, refraction, etc.) are assumed to vary linearly within short distances. The probe position in the standard system is found by interpolation of the differences of the star positions in the telescope system and the standard system.

Soviet test observations of stars with known coordinates have shown the position differences between the topocentric system and the star catalog are constant, with sufficient accuracy, for stars located within a 2° by 2° viewing area. There was, therefore, no need for interpolation. In correcting the probe position read from the control panel dials, the mean stellar correction could be used. Space probes tracked by this system included "Luna-11", "Luna-12", and "Luna-13", as well as one of the "Molniya-I" series.

STANDARD OPTICAL TRACKING SYSTEM



(UNCLASSIFIED)

Figure 1

NEW SOVIET OPTICAL TRACKING SYSTEM

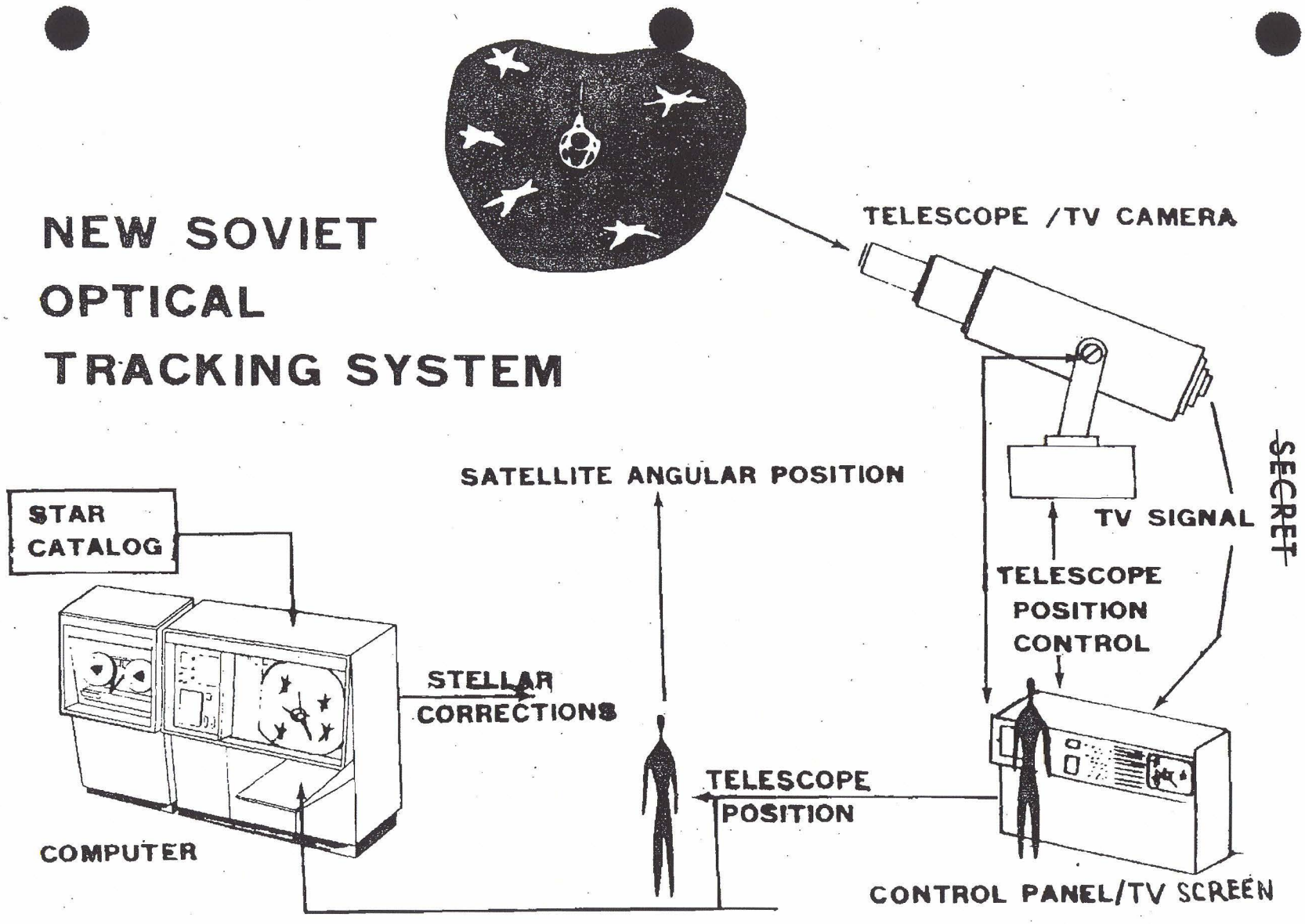


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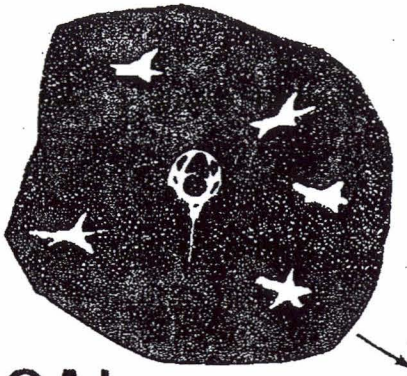
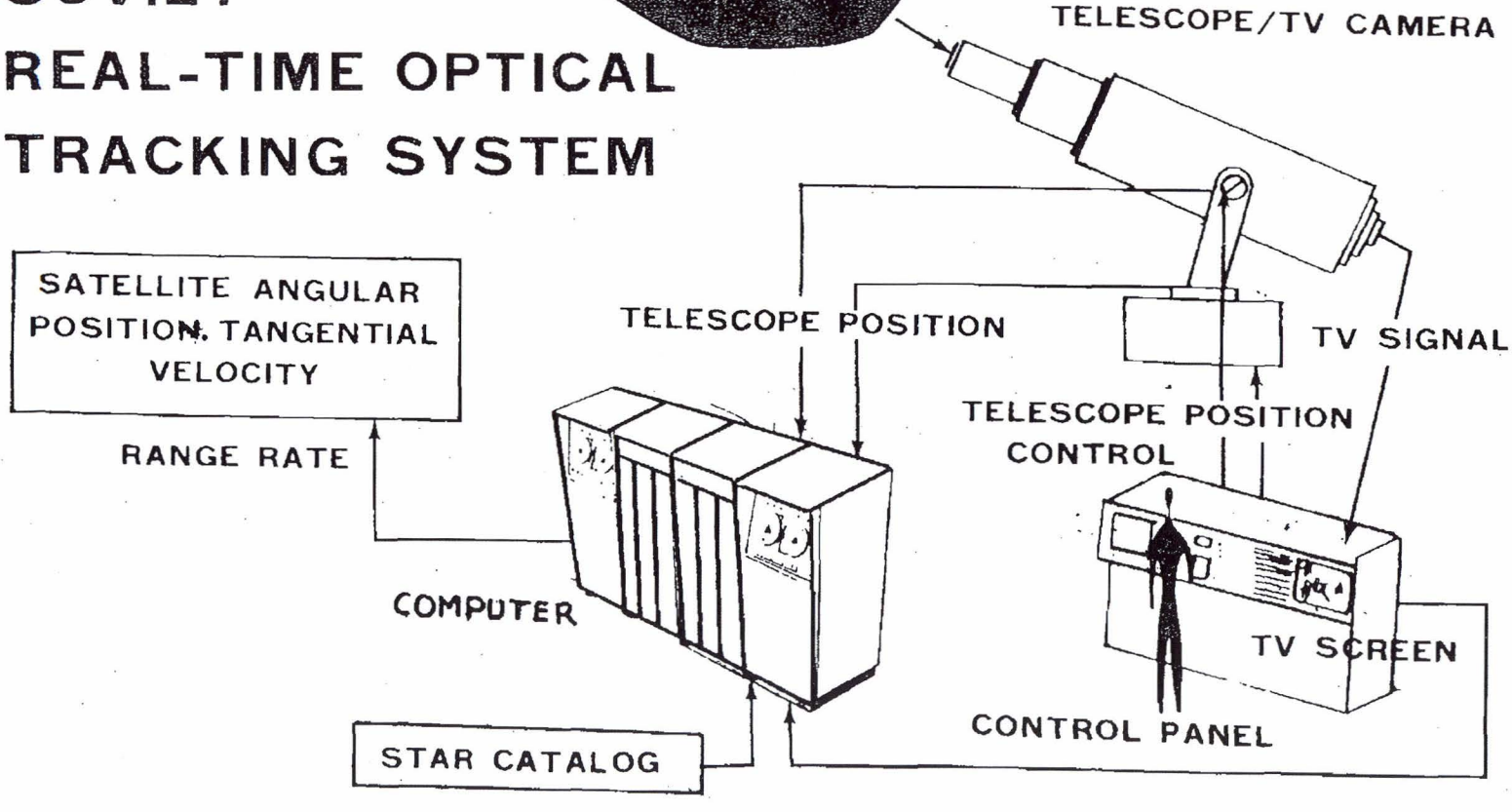
Figure 2

PROBABLE SOVIET REAL-TIME OPTICAL TRACKING SYSTEM





(UNCLASSIFIED)

Figure 3

The steps in conventional optical tracking are shown schematically in figure 1. The photo microcomparison procedure is especially time-consuming, often requiring several months. The new Soviet system (figure 2) achieves similar accuracy in a much shorter time. No photographic processing or measurement of film and plates is necessary, and distortion effects can be ignored since all measured images are placed at the center of the TV screen. Moreover, position corrections for precession are made automatically during coordinate transformation.

This method can provide the Soviets with near real-time data, but several modifications would allow significantly faster response using essentially the same components. True real-time optical tracking is possible with the technique shown schematically in figure 3, which is postulated as a highly probable development of the system described above.

The proposed system would operate in the following manner:

1) The technician, at the control panel, maneuvers the telescope so that the probe image remains on the cross-hairs of the TV screen;

2) Telescope position is fed directly from the telescope mount to a high speed electronic computer;

3) The relative displacements of the reference stars from the cross-hairs can be electronically sensed and fed to the computer;

4) The computer updates stellar positions from a standardized star catalog to determine the necessary corrections to convert probe position to a standard coordinate system;

5) The speed of the computer in both data sampling and calculation allows the determination of apparent tangential velocities by differentiation of the position data (which cannot be accurately and quickly accomplished by the other systems);

6) The probe position data can be combined from several observing stations to determine orbits and ranges, using normal triangulation.

Such a system is clearly within existing Soviet technical capability. An operational Soviet system is expected in the near future. The U.S. does not presently have a similar operational system. (The overall classification of this item is ~~CONFIDENTIAL~~.) ~~(Gp 3 -- Downgraded at 12 year intervals; not automatically declassified.)~~ (NO FOREIGN DISSEM).