



MULTIPLE MIRROR TELESCOPE OBSERVATORY

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Design Summary of the 6.5 Meter telescope Instrument Rotator Control System Using a Tape Feedback Encoder

Subject: Conversion Technical Memorandum 92-1

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Abstract:

The 6.5 meter telescope will be mounted on the existing MMT altitude-elevation (Alt-Az) mount. Tracking with an Alt-Az mount causes the cassegrain field to rotate during observing. This rotation is corrected by precisely counter rotating the entire cassegrain instrument.

A graduated encoding tape to be mounted around the circumference of the rotator bearing is proposed. The encoding tape will provide rotator position feedback to a VMEbus computer. The resolution requirement of 2^{18} bits is derived from the desired pointing and tracking performance. The sources of position error and their effects on accuracy are presented. An accuracy of 0.05 arcseconds RMS at the edge of a 1.0° field appears feasible with the proposed encoding tape, using achievable mounting tolerances and software error correction.

¹With appreciated technical support and criticism from
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Introduction:

A VMEbus computer with a dedicated motion controller will generate the position commands and monitor the instrument rotator position. The rotator position will be encoded by a Farrand Inductosyn².

The Inductosyn can be thought of as a rotary transformer with two secondaries. The rotating primary is mounted on a spring steel tape. The tape is wrapped around the circumference of the axis to be measured. The stationary secondaries are mounted on a slider³ that spans 4 inches of the tape. Four to eight sliders are distributed around the circumference to average the effects of runout, concentricity and scale accuracy.

The tape Inductosyn scales with multiple curved sliders has the resolution of friction driven encoders with a potentially simpler mechanical installation and alignment. This advantage is offset by complex interface electronics.

The tape mounting surface must have a runout of less than ± 0.001 inches. The required air gap between the tape and the slider is 0.007 inches and must be uniform across the slider. The variation in air gap due to runout, eccentricity, concentricity and vibration can not exceed ± 0.001 inches.

The ultimate accuracy of the tape system depends on the ability to compensate for mounting tolerances. The non-cyclic variation of surface runout and tape accuracy are minimized by averaging readings from all the sliders.

The cyclic errors can be minimized in software and with multiple sliders. To correct for the twice per revolution error of eccentricity, two sliders 90 degrees apart are required. To correct for the once per revolution error of concentricity, two sliders 180 degrees apart are required. To allow the use of shift registers to perform the high speed division required for averaging, the number of sliders should be a power of two (2,4,8...). This sets the minimum number of sliders to four.

²Farrand Controls; 99 Wall Street; Valhalla, NY 10595-1447

³slider; a read head, made up of sine and cosine windings