eliminate the aluminized mylar tape, and apply either printed mylar strips or black paint directly onto the track.

The other weakness of this hybrid encoder is that it does not know where the dome is pointing when it is first turned on. (This weakness is shared by all incremental encoders.) To determine the initial position, the dome must be rotated so that at least one absolute position tag passes the read head. In fact, the start-up sequence requires that three such tags be read correctly and in the proper sequence to insure that the system is properly functioning. This deficiency could be partially corrected by using a small lithium battery (the type commonly used on "time of day/calendar" cards found in personal computers) to provide battery backup for the microprocessor's memory so that the dome position would be retained if external power were lost. The 65/11EB microprocessor provides a connection precisely for this purpose.

However, providing battery backup for the memory is not a complete solution. If the dome were in motion at the time a power failure occurred, it might continue to coast a considerable distance after the power went out. The motion during the coast would not be seen by the encoder, since it would be without power. The microprocessor memory would retain the position of the dome at the time of the power failure, and would be in error by an amount equal to the coast distance. After power was restored, the system would have an approximate position for the dome, but would need to read at least one absolute position tag to recalibrate. If this proved to be a serious problem, battery backup power could be supplied for the complete encoder system. Five volts at 1.5 amps would be required.

Other impacts

The ability to measure dome position accurately and reliably brings with it a number of benefits. First, it prevents the loss of observing time that results from an improperly positioned dome occulting the telescope field of view. Second, for certain maintenance operations, it may aid in the precise positioning of cranes and hoists that are attached to the inside of the rotating part of the dome. (This is particularly important during mirror-handling operations at the Keck 10-meter Telescope.) Third, for older telescope domes that were built with very large slits, it may make it possible to decrease the effective slit width and reduce the exposure of the telescope to wind-induced vibration.

This third benefit will be an important one for the Shane 3-meter telescope. It was built in the 1950's, and its dome slit is approximately twice as large as the diameter of the primary mirror. Once the new hybrid encoder is installed on this dome, the dome slit will be kept more tightly positioned in front of the telescope, provided the existing dome drive motors can handle the increased duty cycle. If this works out, then possible modifications to the windscreen will be examined as a means of narrowing the effective width of the dome slit to provide increased protection from the wind. By reducing wind-induced vibration, the performance of the telescope on windy nights will be greatly improved.

Conclusion

One might argue that the hybrid encoder seems conceptually more complicated than an absolute encoder mechanically coupled to the dome through a reduction gear. The same argument might be made comparing pocket calculators and slide rules. The important point is that while logical complexity may be increased by this system, mechanical complexity is reduced. We believe that the hybrid encoder system will prove less expensive, more reliable, easier to maintain, and provide greater accuracy and precision than the traditional solution.

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