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A hybrid incremental/absolute optical encoder for measuring the position of telescope domes

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Abstract

This report presents a design for an inexpensive and highly reliable dome position encoder which has few moving parts and which eliminates the need for a mechanical engagement to the dome. This hybrid incremental/absolute optical encoder is now in use on the dome of the 1-meter Nickel Telescope at Lick Observatory, and will soon be installed on the dome of the Observatory's Shane 3-meter Telescope. This report discusses the costs and important points of the construction, installation, operation, and maintenance of the encoder. It also explores the feasibility of using this encoder on the domes of large telescopes such as the Keck Observatory 10-meter.

Introduction

Dome position has traditionally been encoded by mechanically coupling a rotary encoder to the edge of the dome. Different types of mechanical pick-offs have been used, such as rubber pinch-rollers or chain and sprocket assemblies. While these couplings may work well for many years, they can become unreliable after decades of mechanical wear. Older domes that shake, wobble, and nutate as they revolve can cause these parts to wear out even faster. Both the 100-year-old dome on the 1-meter Nickel Telescope and the 30-year-old dome on the 3-meter Shane Telescope have suffered from unreliable dome pointing caused by worn mechanical couplings between the position encoder and dome. In an effort to solve these problems and prevent their recurrence, a new type of position encoder was developed which eliminates the need for this type of mechanical coupling.

This new design uses the dome itself as a major component of the encoder. A band of reflective material imprinted with a coded pattern of stripes is attached to an inner surface of the rotating portion of the dome. (See Figure 1.) This pattern consists of two separate tracks: a timing track, which provides an incremental position, and a data track, which provides the absolute position. As the dome rotates, these tracks move past a read head mounted on the stationary part of the dome building. The read head contains optical sensors that detect changes in reflectivity as the stripes move past the sensors.

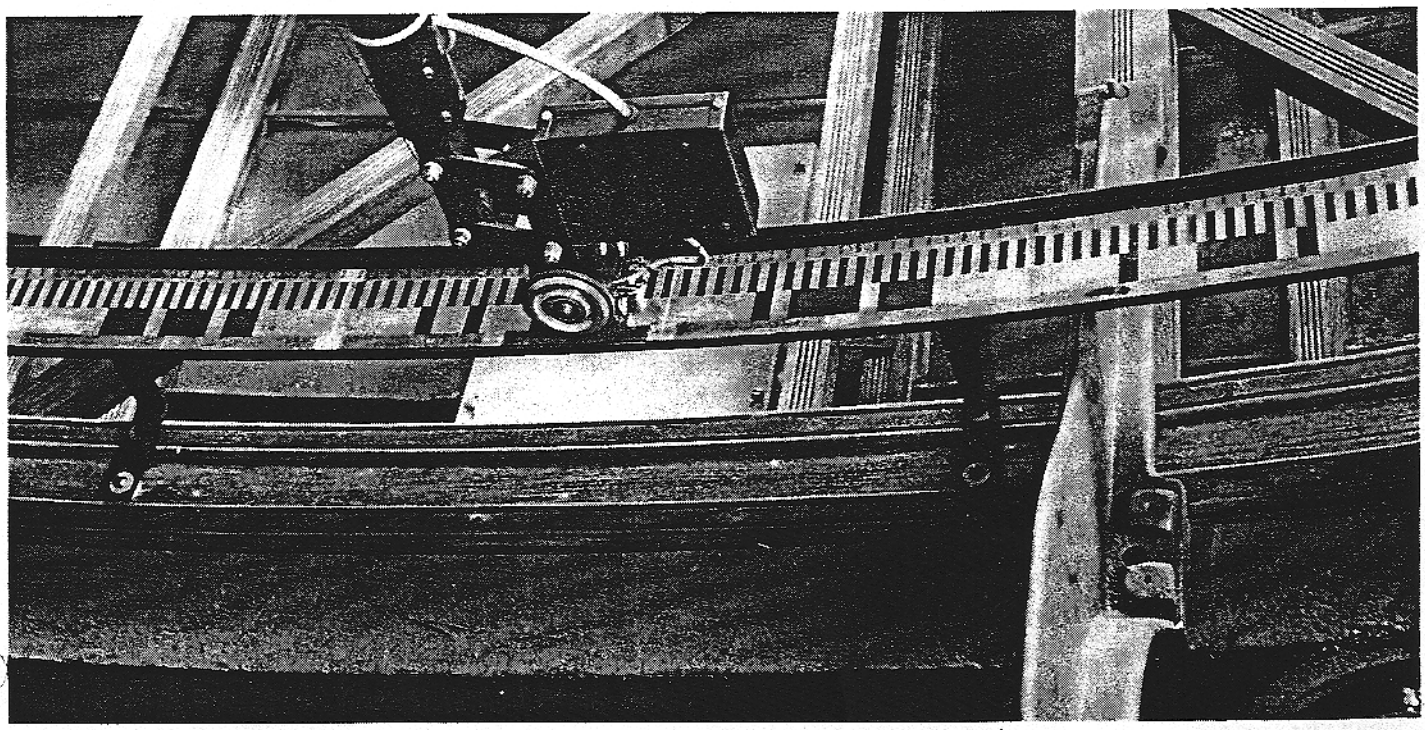

Figure 1. Printed mylar strip on encoder track, and encoder read head parallelogram linkage.