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Mapping the effects of thermal gradients for correction of refractive index variation inside the lunar laser ranging telescope tube

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Investigating the magnitude of air temperature variation inside the Lunar Laser Ranging (LLR) telescope tube is important for determining the varying refractive index and divergence angle of the emitted laser beam along the optical axis. Such investigation is important for the operational performance of optical laser telescopes, particularly the LLR one-meter aperture telescope that is under development at the Hartbeesthoek Radio Astronomy Observatory (HartRAO) which is expected to achieve sub-centimeter range precision to the Moon, for enhanced tests of Earth-Moon system dynamics. In particular, this study presents analysis of the inside-tube air temperature variation along the optical axis of the LLR tube assembly model as a result of pre-set ambient temperature and wind conditions that are representative of the HartRAO site. Results show that with ambient temperature and wind speed of 30 °C and 8 km/h respectively; air temperature decreases from the inner-tube surface (~29.95 °C) toward the tube center (~28.95°C) with regional temperature variations of about 0.1 °C occurring in a radial manner over a time period of an hour. The results of the simulations indicate that larger variation in the refractive indices occurs closer to the secondary mirror. Furthermore, we report on the refractive indices and divergence angle estimated for different temperatures along the tube optical path. These findings indicate that the variation of the index of refraction must be compensated in areas away from the primary mirror. This has significant implications for providing options for active thermal mechanisms for the tube assembly.

Apply to be considered for a student award (Yes / No)?

Yes

Level for award (Hons, MSc, PhD, N/A)?

PhD

Main supervisor (name and email) and his / her institution

Prof. Ludwig Combrinck

Would you like to submit a short paper for the Conference Proceedings (Yes / No)?

Yes

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