भारतीय ताराभौतिकी संस्थान

INDIAN INSTITUTE OF ASTROPHYSICS

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स्नातक अध्ययन मंडल **Board of Graduate Studies**

IIA - CU - PhD (Tech) Public Ph.D viva-voce examination

वक्ता **Speaker:** V Sreekanth Reddy

शीर्षक **Title:** Development of High-Resolution System for Stellar Imaging

सार Abstract

Adaptive Optics (AO) technology is a part of ground-based astronomical observatories around the world. It enables the telescopes to attain near diffraction-limited resolution. We have designed, developed and tested a tip-tilt image motion compensation system for 1.3 m J.C. Bhattacharya (JCB) telescope at Vainu Bappu Observatory, India. This thesis includes the measurement of turbulence parameters, design development and demonstration of a tip-tilt instrument. Measurement of atmospheric turbulence parameters on-site of the telescope is essential prior to the development of an AO system. The atmospheric turbulence parameters namely, atmospheric seeing, the tilt-anisoplanatic angle (θ_0) and the coherence time (τ_0), were measured under various sky conditions. Bursts of short exposure images of selected stars were recorded with a high-speed, frame-transfer CCD mounted on the telescope. The estimated median seeing is ≈ 1.85″ at wavelength of ≈ 600 nm, the image motion correlation between different pairs of stars is ≈ 44% for θ_0 ≈ 36″ and mean τ_0 is ≈ 2.4 ms.

The optical model of the instrument was designed in ZEMAX ray-tracing software. The diffraction-limited field of view (FOV) of the instrument is 1′ X 1′ with a wavelength range of 0.48 - 0.7 μm. A telescope interface unit was designed in *AutoCAD* and fabricated to house all the sub-components of the system. Control software with graphical user interface was developed in LabView software. To characterize its performance, the instrument was thoroughly tested in the laboratory by creating the image motion using image centroid data recorded on the telescope. The instrument was commissioned on the telescope to analyze its performance in real-time. The tilt corrected images have shown up to ≈ 57 % improvement in image resolution and corresponding peak intensity increased by a factor of ≈ 2.8. A closed-loop correction bandwidth of ≈ 26 Hz has been achieved with on-sky tests and the *root mean square* motion of the star image has been reduced by a factor of ≈14. These results are not only consistent with theoretical and numerical predictions of image quality improvement expected from a real-time control system but also consistent with the reports of the performance of similar systems elsewhere in the world.

बुधवार Wednesday 24, फरवरी February 2021

Time: 2:30PM

Remotely online

सभी का स्वागत है All are welcome

Meeting link
https://us02web.zoom.us/j/5202382380?pwd=ajV5OHVRYVE3UU93a2FtbEtuRmNGdz09

Meeting ID: 520 238 2380
Passcode: IIA-THESIS