

Performance Evaluation of a Very High-Resolution Satellite Telescope

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Abstract : System performance evaluation is an essential stage in the design of high-resolution satellite telescopes prior to the development process. In this paper, a system performance evaluation of a very high-resolution satellite telescope is investigated. The evaluated system has a Korsch optical scheme design. This design has been discussed in another paper with respect to three-mirror anastigmat (TMA) scheme design and the former configuration showed better results. The investigated system is based on the Korsch optical design integrated with a time-delay and integration charge coupled device (TDI-CCD) sensor to achieve a ground sampling distance (GSD) of 25 cm. The key performance metrics considered are the spatial resolution, the signal to noise ratio (SNR) and the total modulation transfer function (MTF) of the system. In addition, the national image interpretability rating scale (NIIRS) metric is assessed to predict the image quality according to the modified general image quality equation (GIQE). Based on the orbital, optical and detector parameters, the estimated GSD is found to be 25 cm. The SNR has been analyzed at different illumination conditions of target albedos, sun and sensor angles. The system MTF has been computed including diffraction, aberration, optical manufacturing, smear and detector sampling as the main contributors for evaluation the MTF. Finally, the system performance evaluation results show that the computed MTF value is found to be around 0.08 at the Nyquist frequency, the SNR value was found to be 130 at albedo 0.2 with a nadir viewing angles and the predicted NIIRS is in the order of 6.5 which implies a very good system image quality.

Keywords : modulation transfer function, national image interpretability rating scale, signal to noise ratio, satellite telescope performance evaluation

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