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Radiation Pattern Analysis and Optimization for Leighton Chajnantor Telescope

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Leighton Chajnator Telescope (LCT, i.e., the former Caltech Submillimeter Observatory telescope) will be reassembled in Chile in 2026. Reassembly of its 10.4m segmented primary reflector is of great importance because it determines the surface accuracy and hence the performances of the antenna's radiation pattern, which has significant influence on the angular resolution of the telescope. In order to ensure the angular resolution of 8 arcsec, the performances of the radiation pattern of LCT's antenna needs to be analyzed accurately and optimized carefully by tuning the actuators installed on the backup structure, under the deformation of the primary reflector caused by segmented panel misalignment and gravitational load. In this research, a numerical method for calculating the radiation pattern of LCT's antenna quickly is proposed based on optical path difference calculation, Zernike polynomial fitting and aperture integration, which achieves high computational accuracy and efficiency at the same time. Furthermore, a superposition principle is proposed for analyzing the radiation pattern performances when multiple actuations work together, based on which the method of optimizing the regulation of actuators is developed for improving these performances. Numerical experiments are conducted to verify the feasibility and efficiency of the proposed methods, which will be helpful to ensure good radiation pattern performances of LCT during is reassembly.

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