

Novel design method proposed for reflective optical system with low tilt-error sensitivity

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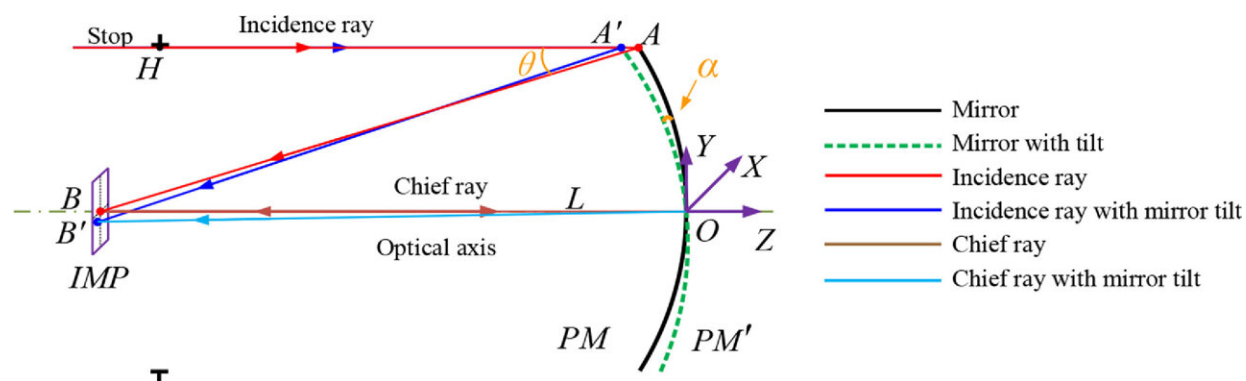


Fig. 1. Mathematical model of single-mirror optical system. Credit: DOI: 10.1364/OE.447556

Characterized by large aperture and long focal length, the reflective optical system has the advantages of small number of optical elements and simple optical structure. But the intrinsic aberration and the misalignment derived aberration increase exponentially with the increase of focal length and aperture, resulting in a significant degradation of the optical system imaging quality caused by just a small amount of misalignment.

In a study published in *Optics Express*, Prof. Meng Qingyu and his Doctoral student Qin Zichang from Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of the Chinese Academy of Sciences

(CAS) proposed a comprehensive reflective optical [system](#) design method with low tilt error [sensitivity](#). This method not only optimizes the imaging performance of the system and controls the tilt error sensitivity of the optical system, but also considers the uniformity of the sensitivity of each mirror of the system.

Using the method of geometric optics, the researchers established the mathematical analysis models of single-mirror system and two-mirror system. Through the theoretical derivation of the relationship between the variety of optical path difference (OPD) caused by the tilt of optical system and the parameters of optical system, they concluded that the system with large incidence angle has greater variety of OPD and higher sensitivity when the tilt error applied, and the tangent slope at the intersection of ray and mirror is the key factor to determine the error sensitivity of optical system.

Based on the above finding, the researchers proposed the evaluation function S of tilt error sensitivity of optical system, and established a desensitization design method of reflective optical system. Taking an off-axis three-mirror optical system with a [focal length](#) of 100mm and an F-number of 5 as examples, they compared the tilt [error](#) sensitivity of the two systems before and after the desensitization design by using the proposed method. The results showed that this method is effective.

More information: Zichang Qin et al, Design method for a reflective optical system with low tilt error sensitivity, *Optics Express* (2021). [DOI: 10.1364/OE.447556](https://doi.org/10.1364/OE.447556)

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