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SURFACE CONTROL OF ACTUATED HYBRID SPACE MIRRORS

Abstract

In order to achieve lightweight and high surface accuracy, actuated hybrid mirror (AHM) technology is under development for large space telescopes. AHM consists of a rib-stiffened silicon carbide substrate, a metallic nanolaminate facesheet to provide optical finish, surface parallel actuators, a sensing system, typically a wave front sensor, to determine the surface errors. The system consists of hundreds of sensor outputs and hundreds of actuators. The surface control problem for these mirrors becomes very challenging because of large number of sensors and actuators. It becomes multi-input and multi-output control problem. This paper discusses the different control techniques for surface control of actuated hybrid space mirrors.

Adaptive optics consists of deformable mirror with hundreds of actuators and wave front sensors with hundreds of sensor output. Therefore, the integral control used for adaptive optics will be classical approach for this case. However, this method is not applicable to AHM because the structural frequency of AHM is an order of magnitude lower. This will create structural and control interactions. The classical control is next upgraded by using notch filters at the structural frequencies of the mirror. This method has limitations because the coupling between sensors and actuators is not taking into account.

At the Naval Postgraduate School, multi-input and multi-output H-infinity control technique has been used for the surface control of AHM. Since the model is of very high order, model reduction techniques are required for using H-infinity technique. Singular Value Decomposition (SVD) and Zernike polynomial techniques are used for model reduction. H-infinity control technique provides significant higher performance in comparison with classical control techniques. The classical control technique is combined with H-infinity control technique and the resulting technique provides even better performance. This paper will present the results of this research work.