



# Lightweight tn-Plane Actuated Deformable Mirrors for Space Telescopes

*Michael J. Shepherd*

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This research focused on lightweight, in-plane actuated, deformable mirrors, with the ultimate goal of developing a 20-meter light gathering aperture for space telescopes. The 0.127 meter diameter deformable mirror small scale testbed was modelled in finite elements using MSC. Nastran software and then used as a basis for a quasi-static controller. Experimental tracking of Zernike tip, tilt, and defocus modes was accomplished. The analytical solutions to plate-membrane and beam-string ordinary differential equations were developed. A simplified approach to modelling the axisymmetric cases was also presented. A novel static control strategy, the Modal Transformation Method, was developed to form Zernike surfaces within an interior, or clear aperture, region using a number of statically-actuated Bessel-based vibration modes. The scaling problem for membrane optics is addressed. Significantly, it is shown linear modelling may correctly explain the behavior of small-scale models, but only non-linear models will account for the important terms which govern the full-scale large aperture membrane telescopes.

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