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Supression of spurious vibrations by online loop shaping and H-infinity control in Adaptive Optics

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Summary

A new approach for a robust controller for Adaptive Optics systems is proposed. The traditional Optimal Gain Integrator controller is only weakly able to mitigate the effect on the images of spurious external mechanical vibrations present on real-world telescopes. The new controller is designed with the objective of suppressing these vibrations. The controller is synthesized by loop-shaping in the Nyquist diagram by minimization of the weighted infinity norm of the sensitivity function. The new controller is a gain-scheduled H-infinity controller that can be updated in real time as a function of the perturbation frequencies. In addition to the controller, a recursive least square algorithm for online identification of the vibration frequencies is also derived.
The estimation and the controller performances are studied in the case of a sum of sinusoidal perturbations with one, two and three vibrations and compared to the standard integrator controller. The estimator and controller are implemented on the NIRPS instrument via the off-the-shelf ALPAO ACE toolbox for MATLAB.

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