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Optimal control theory for the angular control of the full payload for AdV+ Phase II

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In the present work it is presented a formulation of a new control strategy for the angular degrees of freedom of a Fabry-Perot cavity in the presence of radiation pressure effect for Advanced Virgo+ (AdV+) Phase II experiment. The main difference with Phase I configuration is the introduction of large terminal masses. The different physical dimensions of the two masses and the consequent different momenta of inertia introduce a not negligible asymmetry of the mechanical system which is translated in an impossibility of decoupling all the degrees of freedom. Given this difficulty, the possibility of designing SISO controllers (Single Input-Single Output) is left out. A new approach of designing MIMO controllers (Multi Input-Multi Output) in time-domain is investigated. Optimal Control Theory is used in order to design controllers which allow, by the minimization of a specific cost function, to obtain direct closed-loop stability with the optimal phase margin available. The present work will explain different topics: starting from the analytical description of the Fabry-Perot cavity, first (i) a State Space formulation of the mechanical system is obtained; then (ii) the design of a LQI control (Linear Quadratic Integral regulator) is described; to complete the control loop design architecture, (iii) the design of a state estimator, i.e. Kalman Filter, is reported, by using realistic data of sensors noise in order to evaluate robustness and convergence limitation of the filter.

Submitted on behalf of a Collaboration?

No

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