A Robust Predictive Control Formulation for Heliogyro Blade Stability

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Abstract: The generalized predictive control (GPC) algorithm provides a framework with which to approach challenging systems of considerable non-linearity. Its implementation of on-line system identification techniques on time-domain response histories gives it the ability to adapt to changes in the system and dynamic environment. This paper presents the relationship between the GPC design parameters and the two conditions to achieve robust GPC: (1) the closed-loop system must be asymptotically stable, and (2) the GPC controller itself must also be asymptotically stable. In order to achieve the aforementioned conditions, an optimization procedure is implemented to obtain the parameters related to the weighting in the controller synthesis, and the prediction/control horizons associated with future behavior. Additionally, this paper briefly presents a discretized representation of a heliogyro-type solar sail system, upon which the derived control method is demonstrated in real-time and shown to improve structural stability under measurement noise and changing environmental conditions.

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