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NUMERICAL SIMULATION AND EXPERIMENTAL VERIFICATION OF A SUPERVISORY CONTROL SCHEME OF A FLEXIBLE BEAM WITH SWITCHING PIEZO ACTUATORS

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Abstract. In this note, we propose a supervisory control scheme in order to address the (possible) performance improvement of a system subject to spatiotemporally varying disturbances within the context of vibration suppression of a flexible beam. This is achieved by switching to different actuating devices at different time intervals. Specifically, the flexible structure under study is assumed to have multiple piezoceramic (PZT) actuators available with only one being active over a time interval of fixed length while the remaining ones are kept dormant. The optimality of switching to a different actuating device with its own switching control signal is with respect to the minimal cost of an associated LQR/LQG performance index that corresponds to each actuator. In the proposed algorithm, a control logic is incorporated that only selects the next actuator to be activated from the set of actuators that spatially lies closer to spatially varying disturbances. Numerical studies and experimental results are presented to support the proposed actuator/controller switching scheme.

Keywords. Supervisory Control, Actuator Switching, Flexible Structures, Spatiotemporal Disturbances, Multiple Models.

AMS (MOS) subject classification: This is optional. But please supply them whenever possible.

1 Introduction

The development of intelligent materials as devices for sensing and actuation spurred the employment of these intelligent materials as prefabricated embedded actuator/sensor pairs in flexible structures and, in general, spatially varying distributed systems. The advent of computing powers and increased capabilities in data acquisition hardware and the complexity of test experiments using these smart structures led to a larger number of actuator/sensor groups used to model more realistic environments such as large flexible structures (e.g. solar sails, membranes). Control techniques are able to provide robustness with respect to temporal components of disturbances but do not adequately address the effects of *local-in-space* and *local-in-time* (impulsive) disturbances. For example, it has been observed in periodic structures that one may encounter vibration amplitudes with local-in-space characteristics which decay exponentially-in-space away from the