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OPTIMAL BOUNDARY CONTROL OF SYSTEMS OF ELASTICALLY CONNECTED PARALLEL BEAMS

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Abstract. The optimal control of a distributed host structure consisting of two Euler-Bernoulli beams coupled in parallel with boundary controllers is considered. An index of performance is formulated which consists of a modified energy functional of two coupled structures at a specified time and penalty functions involving boundary control forces. The minimization of the performance index over these forces is subject to the equation of motion governing the structural vibrations, the imposed initial conditions as well as the boundary conditions. A maximum principle is derived for such a system and then the optimal control law is obtained using this maximum principle and the applicability of the results is demonstrated. The effectiveness of the proposed control mechanism is illustrated numerically.

Keywords. Boundary control, maximum principle, parallel Euler-Bernoulli beams.
AMS (MOS) subject classification: 49K20, 74K10, 74M05, 93C20.

1 Introduction

Active control of vibrations of flexible structures is of significant importance in many branches of engineering and in particular for large space structures due to low natural damping and the size of these structures. An effective and practical technique for active control is conducted through a mechanism acting on the boundary points of the structure.

The present study focuses on the problem of controlling the vibration of flexible structures that consist of two Euler-Bernoulli beams coupled in parallel by means of the application of boundary actuators. Our interest in this study was motivated by the works of Najafi et al [11], where it was shown that the system is uniformly exponentially stabilizable by an appropriate application of either distributed or boundary control.

The purpose of this study is to deal with the control of two parallel simply supported beams coupled by pointwise springs with controllers applied along the boundaries of the beams. The basic control problem is to minimize a given performance index in a given period of time with the minimum expenditure of force. The index of performance includes the displacement and