Input-Output Decoupling with Stability for Bond Graph Models

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Abstract: In this paper, the geometric approach and the bond-graph methodology are combined to characterize the structure of square linear systems modeled by bond-graph. A new concept is defined to emphasize the symbolic expressions of the fixed modes of the decoupled model and to design decoupling state feedback laws.

Keywords: Bond graphs; linear systems; non-interacting control; stability properties.

Mathematics Subject Classification (2000): 34D20, 93C15, 93D25.

1 Introduction

The bond graph is an appreciated tool for physical systems modelling. Based on power flows representation, it enables the description of the system through energy storage and dissipative elements [10, 16]. In a control objective, the structure of the chosen model is also of greatest importance: closed loop requirements may depend on groups of elements of the open loop model. Refining these parts of the model would enable to meet the control goals more efficiently, provided that these refinements also improve the model accuracy. In an input-output decoupling objective, the aim of this work is to identify, on the bond graph model describing the system, the elements involved in major properties of the control solution.

Suitable tools for both structural analysis and synthesis of input-output decoupling control laws are defined by the geometric approach [1, 22]. In particular, many contributions have been brought about input-output decoupling by regular static state feedback, in which the structure of the open loop model is of greatest interest. This structure especially enables to know whether the model is decouplable [5–8, 11, 13]. If so, some poles of the decoupled model are also shown to be independent of the control law, so-called fixed modes [9, 12]. Suitable tools for the structural synthesis of such input-output decoupling