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Complementary Matrices in the Inclusion Principle for Dynamic Controllers

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Abstract: A generalized structure of complementary matrices involved in the input-state-output Inclusion Principle for linear time-invariant systems (LTI) including contractibility conditions for static state feedback controllers is well known. In this paper, it is shown how to further extend this structure in a systematic way when considering contractibility of dynamic controllers. Necessary and sufficient conditions for contractibility are proved in terms of both unstructured and block structured complementary matrices for general expansion/contraction transformation matrices. Explicit sufficient conditions for blocks of complementary matrices ensuring contractibility are proved for general expansion/contraction transformation matrices. Moreover, these conditions are further specialized for a particular class of transformation matrices. The results are derived in parallel for two important cases of the Inclusion Principle namely for the case of expandability of controllers and the case of extensions.

Keywords: linear time-invariant continuous-time systems; dynamic controllers; inclusion principle; large scale systems; overlapping; decomposition; decentralization;

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