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Linear time–varying commutative dynamic systems with overlapping decompositions

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ABSTRACT

The inclusion principle has been proposed as one of powerful tools for analysis and control design of complex and large scale systems [1]. This principle is in fact a mathematical framework to describe relations and behaviour between two dynamic systems with different dimensions, in which solutions of the system with larger dimension include solutions of the system with smaller dimension. Both systems are related through linear transformations (expansions and contractions) that have the freedom in selection of the complementary matrices. The inclusion principle has been effectively used in the design of overlapping decentralized controllers. This means that the system to be controlled is first expanded to a larger dimensional system with overlapped components (in inputs, states and outputs). Then, a decentralized controller is designed for the expanded system and contracted to be implemented in the original system. Recent results include a new general characterization of the complementary matrices which is involved in the expansion-contraction process [2]. An application of these results on the design of overlapping state linear quadratic optimal control for linear time-invariant systems is presented in [3]. This poster presents an extension of these results from linear time-invariant systems to linear time-varying systems. First, implicit conditions for the complementary matrices are given for a general form of the time-varying systems. Second, explicit conditions and a systematic selection procedure for these matrices is derived, involving overlapping decentralized state quadratic optimal control, for the class of linear time-varying systems that exhibits the commutativity property. Two important classes of complementary matrices are selected to offer results computationally attractive.

References

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