

Overlapping decentralized controller design for neutral systems with distributed time-delay

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For many large-scale systems, decomposition techniques are usually necessary to obtain useful controllers. Many large-scale systems, however, may involve subsystems which are strongly interconnected through certain dynamics (which form the "overlapping part") but loosely interconnected otherwise. For such systems, controller design based on disjoint decompositions may easily fail. It has been shown for the case of finite-dimensional systems, however, that controller design based on "overlapping decompositions" may produce useful results. Many large-scale systems, however, may also include time-delays. Such time-delays, may be point-wise or distributed. Since point-wise delays may also be represented in distributed form, however, distributed time-delay representation is more general. A controller design approach, based on overlapping decompositions, for retarded systems with distributed time-delay has recently been introduced by the present author [1]. In this talk, we further generalize this approach to neutral systems with distributed time-delay. Specifically, we first define the "extension principle" for such systems and present necessary and sufficient conditions for one system being an extension of the other. The extension principle is then used to design overlapping decentralized controllers for an overlappingly decomposed neutral system with distributed time-delay. In this approach, the overlappingly decomposed system is first "expanded" such that the overlapping subsystems appear as disjoint in the expanded spaces. Decentralized local controllers are then designed for each subsystem. These controllers are then "contracted" to obtain an overlapping decentralized controller for the original system. It is shown that, if the decentralized controllers stabilize the expanded system and satisfy certain performance requirements, then the contracted controller stabilizes the original system and satisfy corresponding performance requirements.

- [1] Iftar A., Extension principle and controller design for systems with distributed time-delay, *Kybernetika* **53**(4):630–652, 2017.

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