ID de Contribution: **5** Type: **Non spécifié**

Stabilization of networks of hyperbolic systems with a chain structure

jeudi 19 octobre 2023 16:30 (1 heure)

In this talk, we focus on recent developments for the stabilization of networks of elementary hyperbolic systems with a chain structure. Such a structure arises in multiple industrial processes such as electric power transmission systems, traffic networks, or torsional vibrations in drilling devices. The objective is to design output feedback control laws that stabilize the chain using the available actuators and sensors. The different systems composing the network are called elementary in the sense that when taken alone, we know how to design stabilizing output-feedback control laws. We will first consider the case where the actuators and sensors are available at one end of the chain. Using appropriate state predictors, we will present a recursive approach to stabilize the whole chain. Then, we will focus on the case where the actuators and sensors are only available at the junction between two subsystems composing the chain. We will show that such a configuration does not always guarantee the controllability of the chain. Under appropriate controllability/observability conditions, we will design simple stabilizing control laws. Our approach will be based on rewriting the system as Integral Delay Equations (IDEs) with pointwise and distributed control terms. Finally, we will show how the proposed techniques can be used to develop output feedback control laws for traffic flow on two cascaded freeway segments connected by a junction.

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