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Further Results on Sliding Manifold Design and Observation for a Heat Equation.

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Abstract: This article presents new extensions regarding a nonlinear control design framework that is suitable for a class of distributed parameter systems with uncertainties (DPS). The control objective is first formulated as a function of the distributed system state. Then, a control is sought such that the set in the state space where this relation is true forms an integral manifold reachable in finite time. The manifold is called a Sliding Manifold. The Sliding Mode controller implements a theoretically infinite gain but with finite control amplitudes serving as an effective tool to suppress the influence of matched disturbances and uncertainties in the system behavior. The theory is developed generically for a finite dimensional Jordan Canonical representation of the DPS. The controller manifold design is described in detail and the observer manifold design can be described in a dual manner. Finally, the control law is expressed in terms of the distributed state. However, in a temperature field control problem motivated by a robotic arc-welding application, the simulations presented are done in the standard manner: a reduced-order finite-dimensional model is used to design the controller which is then implemented on a higher-order, still finite-dimensional (truth) model of the system. An analysis of the potential spillover problem shows the effectiveness of our approach. The article concludes with a brief description of the development of an experimental setup that is underway in our Control Systems Lab.

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