Abstract

Many of the classical approaches to controller synthesis do not scale well for large and complex systems. This is mainly due to computational complexity and the lack of distributed structure in the resulting controllers. It is important that limitations on the information given and processed by sensors and actuators can be incorporated into the design procedure. However, such constraints may greatly complicate controller synthesis. In this thesis, the need for scalability is addressed and a scalable as well as optimal control law is presented. The criteria on optimality is measured in the H. norm, a norm that is fundamental in the theory of robust control and treats the objective of worst-case disturbance attenuation.

The optimal controller is a state feedback law applicable to linear and time-invariant systems with some symmetry in their structure. More specifically, the system has to be stable and have a state-space representation with a symmetric state matrix. Furthermore, the state and control inputs have to be penalized separately. An analog result is given for infinite-dimensional systems. In the infinite-dimensional case, the criteria on the system are essentially as in the finite-dimensional case, however, somewhat more involved.

Systems with the aforementioned property of symmetry have states that affect each other with equal rate coefficients. Such representations appear, for instance, in different types of transportation networks such as buffer systems. The heat equation is an infinite-dimensional system for which the result is applicable. This equation can model heat conduction systems as well as other types of diffusion, such as chemical diffusion. Examples are included to demonstrate the simplicity in synthesis as well as the performance of the control law.