
KIRSTEN MORRIS, University of Waterloo
Control of Partial Differential Equations

In many systems the physical quantity of interest depends on several independent variables. For instance, the temperature of an object depends on both position and time, as do structural vibrations and the temperature and velocity of water in a lake.

The state of a system modeled by an ordinary differential equation evolves on a finite-dimensional vector space. In contrast, the solution to a partial differential equation evolves on an infinite-dimensional space. For this reason, these systems are often called infinite-dimensional systems. This creates challenging issues in stability analysis and more so in controller design. Another issue is the construction of estimation of the entire solution to the partial differential equations using only measurements taken at a finite number of points. Although there are many similarities, the systems theory for infinite-dimensional systems differs in some important aspects from that of finite-dimensional systems. Also, for systems modeled by PDEs, control system and estimator performance depends not only on the controller/estimator design but also on the location of the control and the measurements. Physical intuition does not always lead to the best choice of locations. Since it is often difficult to move hardware, and trial-and-error may not be effective when there are multiple sensors and actuators, mathematical analysis is crucial.

This short course will provide an introduction to control and systems theory for infinite-dimensional systems. It is expected that a previous course in PDEs and also in functional analysis has been obtained. No previous exposure to control systems theory is assumed.