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A Boundary Backstepping Control Design for 2-D, 3-D and N-D Heat Equation

Authors : Aziz Sezgin

Abstract : We consider the problem of stabilization of an unstable heat equation in a 2-D, 3-D and generally n-D domain by deriving a generalized backstepping boundary control design methodology. To stabilize the systems, we design boundary backstepping controllers inspired by the 1-D unstable heat equation stabilization procedure. We assume that one side of the boundary is hinged and the other side is controlled for each direction of the domain. Thus, controllers act on two boundaries for 2-D domain, three boundaries for 3-D domain and ”n” boundaries for n-D domain. The main idea of the design is to derive ”n” controllers for each of the dimensions by using ”n” kernel functions. Thus, we obtain ”n” controllers for the ”n” dimensional case. We use a transformation to change the system into an exponentially stable ”n” dimensional heat equation. The transformation used in this paper is a generalized Volterra/Fredholm type with ”n” kernel functions for n-D domain instead of the one kernel function of 1-D design.

Keywords : backstepping, boundary control, 2-D,3-D,n-D heat equation, distributed parameter systems
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