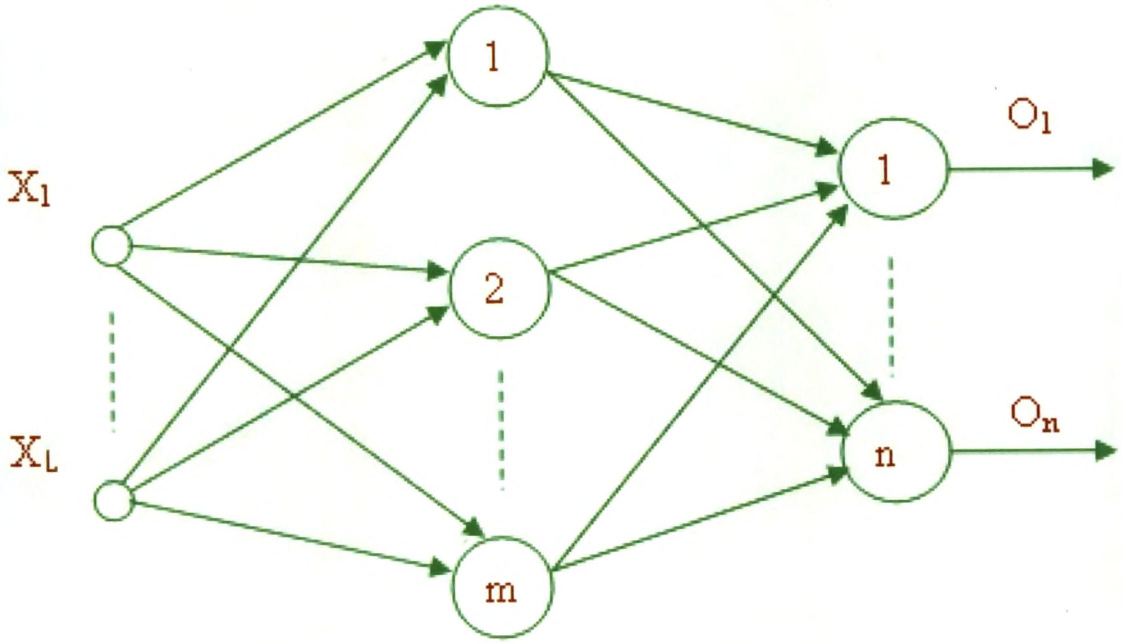
Summary



SUMMARY

The main aim of this thesis is to implement Artificial Neural Networks (ANN) algorithm for the actual computation of steering controls, both for linear systems

$$\dot{x}(t) = Ax(t) + Bu(t)$$

$$x(t_0) = x_0$$

and for the nonlinear systems of the form

$$\dot{x}(t) = Ax(t) + Bu(t) + f(x(t), u(t))$$

$$x(t_0) = x_0$$

The above nonlinear system is called semilinear system.

The investigation related to the use of ANN as controllers in the automated systems is vital, since they can be implemented on VLSI.

The overview of the thesis is given in the Chapter 1. The Chapter 2 contains the mathematical prerequisites for the development of the theory and results in the thesis.

In Chapter 3, we find that the dynamics of Hopfield Neural Networks (HNN), a type of Recurrent Networks is that of a control system. Mathematically, the Hopfield Neural Network is represented by the semilinear dynamical system. For the Hopfield Neural Network, we study the stability, controllability and observability properties. In this chapter, we have shown that the HNN is BIBO stable as well as asymptotic stable.

In Chapter 4, we mathematically model the mixtank process, a subprocess in the Chemical Industry to give the motivation for the study of the controllability property of the dynamical system representation in the continuous semilinear form. The controllability results for continuous semilinear systems are developed in this chapter. This Chapter also contains various implementations of the ANN steering control for the linearized system. Further, the mixtank process in the semilinear form is also investigated for the ANN controller in the semilinear form.

Since, we are interested in implementing the steering control for the automated systems, which are discrete dynamical systems, we have explicitly developed the controllability results for the discrete dynamical systems in Chapter 5. The controllability results for the discrete semilinear system extends the approach taken by Narendra et. al. for the discrete linear systems. This chapter also demonstrates the technique to expand the domain of controllable states for the semilinear systems almost to the complete state space.

In Chapter 6, we have implemented the ANN zonal controllers for the dynamical systems in the linear as well semilinear form. The dynamics of system for the zonal controllability is in infinite dimension which is approximated to the finite dimension by projection technique.

The last chapter, Chapter 7 again deals with the parabolic systems represented in infinite dimension. Such systems are checked for the boundary as well as distributed control. Here we have taken the spatial discretization approach for approximating the systems in finite dimension. Finally the ANN steering control are implemented for the linear as well as semilinear form of the approximated system, for the boundary and distributed controllability.

The established results and the simulations using MATLAB demonstrates that ANN can be easily used as controllers installed on VLSI for the automated nonlinear systems. Hence we conclude that, in the automation industry the ANN controllers have a great role to play.

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