The Application of Control using Neuro Dynamic Programming with Featuring Method

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For general nonlinear processes control problem, the most rigorous approach is to use dynamic optimization. However the dynamic programming (DP) problems are used in just few cases because as the size of the problem grows, the dynamic programming approach is suffered from the burden of calculation which is called as 'curse of dimensionality'. To overcome this problem, a cost-approximator is used for the calculation of cost which consists of error and input change and this helps to select the optimal control input policy to minimize the value of cost. This is called the NDP (Neuro-Dynamic Programming) algorithm. When the one-stage-cost is constructed, the states of process are important element of error in cost. The situation becomes easier if we are dealing with a single input policy, u because the expected cost-to-go under that policy can be estimated. So, the featuring method is introduced, which represents the nonlinear map of states and it makes the estimation be easier. The pH neutralization process is a representative benchmark problem of nonlinear chemical process control and the NDP algorithm with k-nearest neighbor method (kNN) was applied to pH neutralization process in both simulations and experiments.