Using Chebyshev Wavelet in State-control Parameterization Method for Solving Time–varying system

Zahra Rafiei*
Yazd University

Behzad Kafash
Engineering Department,
Ardakan University, Ardakan, Iran.

Abstract

In this paper, a new algorithm based on state-control parameterizatiom method to obtain the solution of time-varying control problem is presented. The state and control variables are expanded by Chebyshev wavelet basis with unknown coefficients and are used to convert optimal control problem into NLP poblem. Applicability of this method is presented by an illustrative example.

Keywords: State-control parameterization, Chebyshew wavelet, Linear time-varying system
Mathematics Subject Classification [2010]: 13D45, 39B42

1 Introduction

Indirect methods have some drawbacks to obtain the solution of systems that are described by strongly nonlinear differential equations. Thus, many reasearchers proposed direct methods to solve these problems. The direct methods convert optimal control problems into NLP problems and then use existing NLP techniques to solve them.
Direct methods are classified into either discretization [9] or parameterization [8] of the state and/or the control variables. In order to solve various classes of optimal control problems several direct methods that use orthogonal polynomials have been proposed. Wavelets as one of these orthogonal polynomials have good property to approximate functions with discountinous or sharp changes. Many authors have used wavelets for solving optimal control problems such as Haar wavelets [1], harmonic wavelet [4], Shannon wavelet [5], Legendre wavelet [6].
In this paper, the focus is on introducing a state-control parameterization method based on Chebyshev wavelet to find optimal solution for a time-variant system. This work is done as follows: First, a brief description of control problem and Chebyshev wavelet polynomials is given. A mathematical description of proposed state-control parameterization method is presented and finally by presenting an example, we compare our proposed method with other reasearchers to determine the validity of the solution of this example.

*Speaker