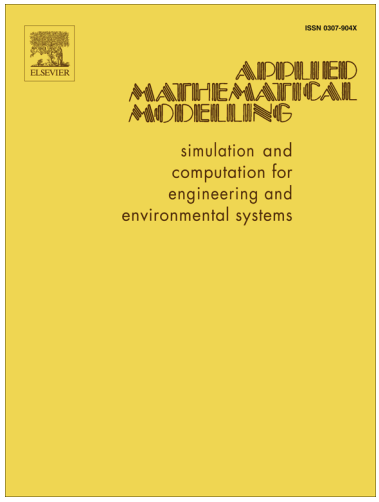

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Linear Time Invariant System Reduction Using Mixed Method Approach

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Abstract

A new method is proposed to obtain reduced order model of high order linear time invariant single input single output (SISO) and multiple input multiple output (MIMO) systems which is based on stability equation method and factor division algorithm. For a given higher order linear time invariant system, the coefficients of numerator polynomial are estimated by factor division algorithm while the coefficients of denominator polynomial are calculated by stability equation method. The distinctive feature of the proposed method is that the reduced model will always be stable if the original system is stable. Numerical examples are taken into consideration to prove the superiority of the proposed method as compared to other well known methods available in the literature.

Keywords: Model Reduction, Stability, Factor Division Algorithm, Stability Equation Method, Integral Square Error.

1. Introduction

In the field of Control System Engineering, system reduction play critical role which transform the higher order model to the lower order model preserving almost all essential properties of the higher order model under investigation. Therefore, for better understanding of the system, this lower order model is used to analyse behaviour of higher order model by which simulation time reduces and design work become easier.

The first method for model order reduction was given by Davison in 1966 [1] which was modified by Chidambara in 1967 [2, 3, 4]. Then, Pade approximation method was proposed by Y. Shamash in 1974 [5] but the major drawback of this method is that the reduced system may be unstable for stable original system. Further, number of techniques were proposed by researchers to approximate the higher order model into reduce order model like Routh approximations [6], stability equation method [7], Chebyshev polynomial techniques [8], Factor division method [9] and polynomial derivatives approach [10] etc.

There are various methods based on minimal realisation have been proposed in the literature [11, 12, 13, 14] and this concept has been extended along with Silvermans algorithm [15]. On the other hand the concept of time moments and/or Markov parameters matching is utilized to obtained reduced order model by several authors for single input single output (SISO) systems [16, 17] and for multi input multi output

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