Accepted Manuscript

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PII: S0377-0427(18)30167-5
DOI: https://doi.org/10.1016/j.cam.2018.03.021
Reference: CAM 11573

To appear in: *Journal of Computational and Applied Mathematics*

Received date : 29 August 2017
Revised date : 13 March 2018

Please cite this article as: N. Alinia, M. Zarebnia, A new tension B-spline method for third-order self-adjoint singularly perturbed boundary value problems, *Journal of Computational and Applied Mathematics* (2018), https://doi.org/10.1016/j.cam.2018.03.021

A New Tension B-Spline Method For Third-Order Self-Adjoint Singularly Perturbed Boundary Value Problems

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Abstract

The aim of this paper is to present a new kind of tension B-spline, called hyperbolic-trigonometric tension B-spline of order n, which is generated over the space span $\{\sin(\tau t), \cos(\tau t), \sinh(\tau t), \cosh(\tau t), 1, t, ..., t^{n-5}\}$, $n \geq 5$, where τ is tension parameter. This kind of B-spline has most properties of usual polynomial B-splines and enjoys some other advantageous properties as well. Also, hyperbolic-trigonometric tension B-spline method is applied for solving self-adjoint singularly perturbed problems. We use some numerical examples to illustrate the accuracy and implementation of the method.

Keywords: Tension; Hyperbolic-trigonometric; B-spline; Third-order; Self-adjoint singular perturbation boundary value problem.

1 Introduction

In recent years, some researchers have proposed several new splines defined in non-polynomial spaces. Zhang [1,2] introduced CB-splines. Koch and Lyche [3] studied exponential B-splines, but these bases do not overlap in the cases of high order. Then, uniform hyperbolic B-splines in the space $\{\sinh(t), \cosh(t), t^{k-3}, ..., t, 1\}$ were proposed in [4]. Some works were also done on C-Bezier basis in the space $\{\sin(t), \cos(t), t^{k-3}, ..., t, 1\}$ in [5,6]. In the same space, Wang, Chen and Zhou [7] constructed nonuniform algebraic-trigonometric B-splines (NUAT splines). Jena, Shunmugaraj and Das [8,9] proposed a subdivision scheme on trigonometric spline. Years later, hyperbolic splines were also extended to the case of nonuniform knot vector in [10]. That is AH splines.

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