ISOGEOMETRIC ANALYSIS FORTHE NUMERICAL SOLUTION OFWAVE EQUATION

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Keywords: Isogemetric Analysis, Cubic B-Spline, Wave Equation, Numerical Method

ABSTRACT

One of the most important issues which is always discussed in science and engineering is solving of differential equations governing the behavior of a system. In recent decades, many numerical methods have been proposed to solve these equations, since only a few of these equations can be directly solved by analytical methods. Among the most common ways, using of the finite element methods in analysis of complex structures and computational mechanics has become commonplace. Following the development of numerical methods, recently a new method of Isogeometric analysis based on NURBS (Non-Uniform Rational B-Spline) functions, provided with the aim of integrating geometry modeling and analysis. The main feature of this method is use of the basic functions of exact geometry modeling as basic functions in analysis of space. According to the importance of this method and also the Isogeometric analysis as a new method known in engineering sciences, in this paper in order to solve the equation of time-dependent we use the third degree of B-Spline (cubic) as the basic functions to numerical solution of differential equation of wave transfer. The results are presented in two space of geometric and time.Finally, some numerical examples are given and the results are compared with exact analytical solution and finite element method results to show the ability and efficiency of this method. The numerical results are found to be in good agreement with the exact solutions. The advantage of the resulting scheme is that the algorithm is very simple so it is very easy to implement.

INTRODUCTION

The wave equation is an important second-order linear partial differential equation for the description of waves (J. N. Reddy 1991). There are a number of candidate computational geometry technologies that may be used in the discretization methods. This approach is based on Isogeometric analysis method. We provide numerical solution to the one-dimensional wave equations, based on IGA method and the cubic B-spline interpolation. IGA method used for discretize the space also the B-spline function is applied as an interpolation function in the space dimension. We present a new procedure using periodic cubic B-spline interpolation polynomials to discretize the time derivative. In the proposed approach, a straightforward formulation (Rogers, D.F. 2001) was derived from the approximation of the time derivative of the dependent variable with B-spline basis in a fluent manner.