# The numerical solution of equation of motion using B-spline wavelet

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## ABSTRACT

Wavelets are mathematical functions that cut up data into different frequency components, and then study each component with a resolution matched to its scale. Wavelets were developed independently in the fields of mathematics, quantum physics, electrical engineering, and seismic geology. Interchanges between these fields during the last ten years have led to many new wavelet applications such as image compression, turbulence, human vision, radar, and earthquake prediction. In this paper, we introduce a procedure using B-spline wavelet basis functions to solve dynamic equation of motion. In the proposed approach, a straightforward formulation was derived from the approximation of the displacement function of the system with B-spline wavelet basis. In this way, B-spline wavelet matrix is derived and applied in dynamic analysis. The validity and effectiveness of the proposed method is verified with several examples. The results were compared with some of the numerical methods such as Haar wavelet, Duhamel integration and Newark (linear acceleration).

**Key words:** Dynamic analysis, numerical approximation, wavelet, B-spline.

## 1 INTRODUCTION

Solving the differential equation of motion governing the SDOF and MDOF systems is done through various methods. Usually the applied loads are not specific mathematical functions therefore, the numerical methods are only option for solving this differential equation.

Wavelets are mathematical functions that cut up data into different frequency components, and then study each component with a resolution matched to its scale. Wavelets were developed independently in many fields [1, 2, 3]. The wavelet theory introduced completely in [4, 5, 6, 7].

B-splines have been long introduced and analysed by [8, 9], which caught interest of many engineering applications. Due to their merits of being flexible and providing a large degree of differentiability and cost/quality trade off relationship, B-splines can represent the next generation of wavelets for solving dynamic equations. In [10, 11, 12], B-splines wavelets were introduced.

In this paper, we introduce a procedure using B-spline wavelet basis functions to solve dynamic equation of motion. In the proposed approach, a straightforward formulation was derived from the approximation of the system's acceleration with B-spline wavelet. By using scale and transmission of B-spline wavelet, first and second integration and initial conditions, we can solve the equation. In this way, B-spline wavelet matrix is derived and applied in dynamic analysis. For this purpose, we used Quadratic B-Spline Wavelet and two-scale relation for making this matrix