# An investigation of extended Euler- Bernoulli beam under impulse load using wavelet spectral finite element (WSFE) method

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***Abstract*: The identification approach that has been proposed incorporates modal forms methodology. performed illustrate recommended method of operation Different situations for decision-making were utilised in different locations. The proposed Euler-Bernoulli Beam Vibration method, as well as the wavelet spectral finite element approach, may both satisfy the requirements at the same time. Sites selected for impact, involvement modes, and outcomes investigated This is the first time in many years that wavelets have been brought into the field. Engineering mechanical problems are solved and assessed using the wavelet transform, which is a kind of mathematical transformation. Among the many applications are mechanical response studies to extract model parameters, sounds, damage assessments, and so on; solution of mechanical system differential equations, transformation, and wave propagation issues; and solution of mechanical system differential equations, transformation, and wave propagation issues using wavelets. Aspects of structural dynamics that are concerned with lower frequencies, such as those that are in the range of vibration, include the investigation and research of a wide range of topics in addition to those already stated. In contrast, the study of transient responses with frequencies in the Kilohertz range, which is generated by high-frequency excitations and includes the research of high-frequency excitations, is produced by low-frequency excitations and includes the investigation of low-frequency excitations. Although this article contains a section on wavelet analysis, the primary emphasis is on the wavelet-based spectrum analysis of wave propagation in this particular topic. The researchers have developed a numerical approach to support their results, and they have utilised a simulation technique to do this.**

***Keywords*: Euler- Bernoulli Beam, Wavelet Spectral Finite Element (WSFE), Numerical Approach**

## I. INTRODUCTION

Wavelets have been in the for a long time. In engineering mechanical difficulties, the wavelet transform is utilized to solve and evaluate problems. The application a variety of including analyses of mechanical responses to extract model parameters, noises, damage measurements, and so on, and solution for mechanical system differential equations; solving transformation and solving and wave propagation problems with wavelets. Structural dynamics is concerned with lower frequencies, such as those range just vibration it includes investigation a in addition to topics. on the other hand, is caused by high-frequency excitations and involves the investigation of transient responses with frequencies in the Kilohertz range.

Techniques for resolving problems involving structural dynamics. It is possible to find an answer to the question through characteristics, primarily forms, the modeling system loads, movement, and so on. When dealing with such as system often connected together. Wavelet analysis is included in this paper as well, although the primary emphasis is on the wavelet-based spectrum analysis of wave propagation. An is simulated the based approach, which is numerical methodology developed by the researchers. This technique adds to the computational efficiency of spectrum analysis while also offering many benefits over Fourier transformed spectral analysis, particularly for catching phenomena that are near to the field of observation.

**Point Loads**

The majority of structural standards and thumb rules are predicated on the assumption that loads are distributed evenly throughout the structure. When it comes to structural components, the issue that we should be most concerned about is the amount of stress they are under. Calculations show that the greatest stress caused by a static point charge is twice as much as the maximum stress caused by a continuously distributed charge of the same amount. This website gives an extremely great explanation of beam loading, so instead than copying their ideas, I'll direct you to them for more information:

In the last section, we discussed how it is simple to "convert" a point load into a uniform load if only the greatest stress is taken into consideration. Material characteristics such as yield stress, which is basically the point at which wood breaks, are defined as follows: In the case of wood, the direction of the grain has a significant impact on the value of y, which is the yield stress. It is thought that the wood will yield to its grain at a much lower stress than it really does. In most cases, wood has a shear stress value of 70 to 100 psi and an axial stress value of more than 1000 psi at maximum tensile strength. As a result of the similarities in these problems between uniform and point loading concerns, they are beyond the scope of this technical note.

**Impulses**

When it comes to platforms that need to be jumped on, impulse pressures are the most problematic. If the platform comes crashing down, the impulse forces will be rendered ineffective. An impulse is defined as a dynamic change that is equivalent to the application of force over a period of time. In terms of mathematics, it looks like this: MOS V = F MOST = MOS V = F MOST

Because we need to calculate the amount of force we must withstand, this equation in the form of F = m is very useful. In other words, we can estimate the power supplied to the platform by computing the change in momentum and the change in time. A human's landing, bending, and leaping take about 0.5 seconds. At that point, their speed is nearly reversed, resulting in a value of = 2v. Consider the case of a typical adult who weighs about 70 kg once again. When a human leaf the ground, he moves at a speed of about 0.5 meters per second. Adding the person's weight to this equation results in a consequent force on the platform of about 140N, or 30.8 pounds, for a total force on the platform of approximately 180 pounds. Due to the fact that this is a point load, the uniform weight is 360 pounds, which is spread evenly across the platform. When using this technique for estimating, keep in mind that shock loads may create vibrations in the joints and connections of your system as well as in the system itself. Keep an eye out for the possibility of the platform being 'jarred' and becoming loose and unglued or completely unglued.

**Wavelet spectral finite element**

Created originally for the purpose of solving fluid dynamics problems, the SEM now combines the flexibility of a Finite Element Technique (FET) with the exactness of a specimen technique in order to generate accurate synthetic seismograms in heterogeneous earth models with changeable geometry. The SEM is a numerical method that is very precise and does not have a tough time dealing with non-flat free surfaces and anelastic attenuation with spatially variable effects. We use a weak formulation of the movement equations, which is calculated on a mesh of hexahedral elements that is suitable for the free surface and the major inner discontinuities of the model, to solve the movement equations. The wavefields on the elements are separated by high-grade Lagrange interpolants, and integration over a single element is accomplished by applying the Gauss-Lobatto-Legendre integration rules to the wavefields (GLL). This ensures that anisotropy and numerical grid dispersion are kept to a bare minimum. By design, the mass matrix of the SEM is exactly diagonal, which simplifies implementation and reduce the cost of computation considerably, since a temporal integration system may be utilized directly without inverting a linear system. It also makes it possible to run many tasks in parallel efficiently. Patera (1984) suggested the SEM as a tool for dealing with problems in computational fluid dynamics. Because of the combination of accuracy and quick convergence provided by pseudo-spectral methods with the geometrical freedom provided by FEM, it has progressed rapidly. Interpolation was founded on Chebyshev polynomials in Patera's initial work, which was published in 1898. (1984). This choice was motivated by the fact that expansions based on Chebyshev polynomials are in accordance with Fourier's (exponential) convergence theory of convergence. Consequently, the word "spectral" in the SEM refers to the exponential convergence that is obtained by increasing the order of interpolating polynomials in a linear fashion. An alternative to Chebyshev SEM was suggested by Maday and Patera (1989), which used a Lagrange interpolation in conjunction with the GLL quadrature, resulting in a diagonal structure of the mass matrix. Several authors, including Komatitsch (1997) and Komatitsch and Vilotte (1998), have utilized the large three-dimensional structures. The advantage of a perfectly diagonal mass matrix was used in the development of an explicit time scheme, which resulted in an efficient parallel implementation.

## II. METHODOLOGY

**Wavelet analysis**

When it comes to land-feature identification and extraction, wavelet analysis is a more advanced frequency analytical method. When compared to the Fourier transformation, wavelet analyses not only reveal the frequency components of a signal, but they also indicate where a specific frequency occurs in the temporal or spatial domain. Wavelet analysis is often performed using the continuous wavelet transform (CWT). The one-size continuous wavelet transform (one-size CWT) is defined as:

$$CWT(a,\tau)= \int_{-\infty}^{\infty} f(x)\frac{1}{a}\Psi^*\left(\frac{x-\tau}{a}\right)dx$$

Because the input data contains a location function x, the scale parameter (which has been transformed to spatial frequency inversion) is a position shift, and the mother-wavelet function is chosen as a complex conjugate based on its mode relative to the target, the following equation may be used: Comparing the continuous wavelet transform (CWT) results with those of the discrete wavelet transform, the CWT findings are easier to comprehend since the CWT operates at all scales (frequency) and the change in wavelet function is continuous. When it comes to wavelet sizes and frequency, the smaller the scale, the higher the frequency of the compressed wavelet; larger scales, on the other hand, represent an extended, lower frequency wavelet. Scales are often modified in order to enhance interpretability in relation to spatial frequencies.

On a debris-covered glacier (the central Karakoram Himalayan Baltoro Glacier), the wavelet analysis is shown to be capable of detecting and distinguishing process regimes on and off the glacier. These process regimes include ablation, suprafluvial transit, and repository. Space analyses have been used to develop a prototype topographic feature that represents the variations in slope-azimuth orientation divergence and convergence. The prototype topographic feature is shown in Figure 1. It is possible to compute an index of slope-azimuth (t) by using the parameter of slope-azimuth (t). In particular, the cosine and sinus functions are used to transform the slope-azimuth parameter, as shown below:

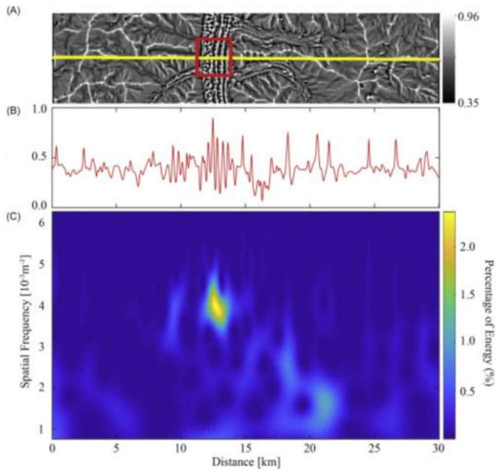

**Fig. 1:** cosine and sinus functions are used to transform the slope-azimuth parameter

The transformation of the wavelet is a critical processing method in potential field techniques, and it has made significant contributions reversal in particular. because wavelet changes the position. It was in the field of seismic data processing that the transformation for many years before. These were brought together by a flurry of theoretical developments in applied mathematics. These advancements have had a major impact on potential field analysis methods, especially magnetic approaches.

Magnetic wavelet applications may be classified into three categories. To begin, natural wavelets produced from Green's magnetic field function were used to extract source parameters from his magnetic field function. Moreau et al. (1997) utilized the CWT for the first time to assess prospective field data for monopolistic sources, which was a first in the area. A similar theory was independently developed and replicated in a seminal study by Hornby et al. (1999), which was a milestone work in the area of computational work theory (CWT). A point monopoly source's potential is represented by wavelets that are mainly The translation of a wavelet, which horizontally transfers the monopoly "observation" results in formation of the wavelet family of waves. In order to identify the locations and limitations of causative organisms, CWT-based techniques must monitor the wavelet extremes.

An orthonormal wavelet compactly supported discrete transformation based on orthonormal wavelet compactly supported discrete transformations is the second class of methods that is most often employed to manage data (properties in order to better understand them. It is possible by using the wavelet developed by Ridsdill-Smith and Dentith (1999). For the processing of gravity gradiometry denoisation of the wavelet right manner. Magnetic data denotation was accomplished via the employment of a method that was comparable. According to Krahenbuhl et al. (2011), this technique was also used to distinguish between magnetic anomalies and background responses caused by as a result of buried metallic objects. Discrete wavelet transformations are used in a third group of applications to from similar sources. method was used a generalized 3-D investment in a generalized manner.

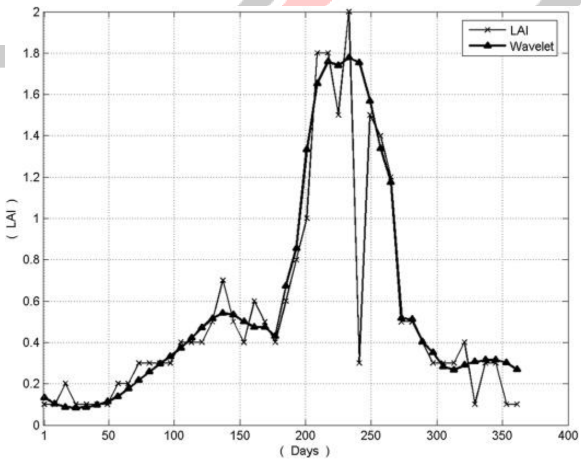


**Fig. 2:** comparison between LAI and Wavelet

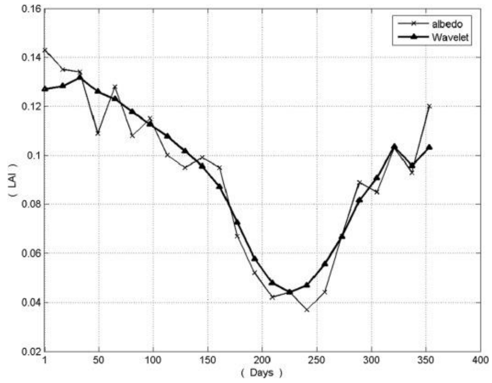


**Fig. 3:** comparison between Albedo and Wavelet

**Orthogonal/Non-orthogonal**

Orthogonality requires the concept of "unknown." An orthogonal model means that all independent variables are uncorrelated with the model under consideration. If one or more of the independent variables are correlated, the model is not orthogonal to the other variables.

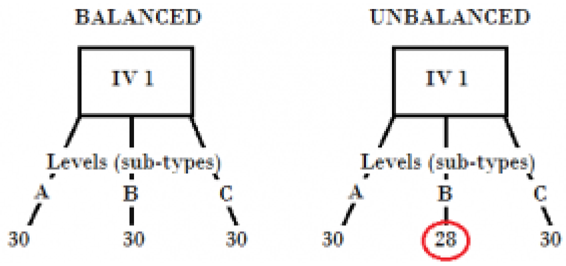


**Fig. 4:** Balanced and Unbalenced

The term "orthogonal" is often used to refer only to the conventional ANOVA. An orthogonal ANOVA includes all independent categorical variables, and the same number of observations is present in each cell of the two-way table. An orthogonal ANOVA contains all independent categorical variables and the same number of observations is present in each cell of the two-way table (called a balanced design). However, generic linear models are never orthogonal since at least one variable is not categorical, which means that the models are never orthogonal (GLMs have one continuous variable).

Orthogonal functions, which are defined as two functions with an internal product of zero, may be found in computed statistics as well as in probability theory. They are very useful in the solution of partial differential equations, such as Schrodinger's and Maxwell's, among other things.

**Vanishing Moments**

A wavelet function's key feature is the number of vanishing times it has, Unlike the Daubechies 2, which has a flushing moment of 2, a wavelet such as the Daubechies wavelet the result is

When transforming as well as any other non-linear trends. An increasing moment of disappearance implies that more moments have been removed from the signal's time history (quadratic, cubic, etc.).

In order to keep the information current, it is necessary to overlap) and re-normalize it. In general, discrete wavelets are both orthogonal and non-orthogonal continuous wavelets, with the latter being the more common.

Symmetry is important.

The middle of the spectrum. When it comes to "time," symmetric wavelets show no preference for one way over another, while asymmetric wavelets provide a variety of orientations with varying weighting.

**The Disappearance of Moments**

A wavelet function's key feature with a mean zero and a linear trend, such as the Daubechies 2, is defined as follows: If you filter away the average and any linear trends from a series using the Daubechies 2 wavelet, you will get a better result. An increasing moment of disappearance implies that more moments have been removed from the signal's time history (quadratic, cubic, etc.).

**Wavelet transforms**

The wavelet transformation is a mathematical method that is widely employed in signal processing applications, such as speech recognition. It has the ability to find and extract unique patterns from large amounts of data. In order to answer the issue of prediction across time series and neural networks, we must represent the situation. As a general estimator, neural networks have limited capability for estimating highly nonlinear systems. In the time-frequency domain, the wavelet transform may both display functions and convey their local characteristics at the same time. Including these characteristics in neural network creation aids in the precise formation of neural networks in the modeling of highly nonlinear signals. There are two types of wavelet transformations: converted wavelet continuous (CWT) and transformed wavelet into discrete wavelet. (DWT). In the presence of continuous scale and displacement parameters in CWT, the CWT transforms very slowly, resulting in the accumulation of extra and nonsensical information due to the overlap and duplication of neighbouring data. As a result, DWT is being used in this research. CWT and DWT are expressed by the equals.

CWT:

$$W(a,b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{+\infty} f(x)\varphi\left(\frac{x-b}{a}\right) dx$$

where a is scale parameter, $b$ is transforming parameter, and $\varphi$ is mother wavelet.

$$W(m,n) = 2^{-\left(\frac{m}{2}\right)} \sum_{t=0}^{T-1} f(t)\varphi\left(\frac{t-n2^m}{2^m}\right)$$

A two-dimensional integer value function (a=2m, b=n2m) is used to represent the length of the signal T. The transform parameters and scale parameters are both integer value functions. In the literature, Stephane Mallat's multi-decomposition theory was often used to apply DWT [27] to various problems. This method is comprised of two basic steps: breakdown and composition. Breakdown is the first stage. Fig. depicts the phases of breakdown and composition. It is during the composition phase that the process of decomposition is reversibly carried out. The family is sometimes referred to as the set of basic wavelet functions (e.g., marlet, har, and Mexican hat), which includes the following functions: [28] Daubechies had more success in this family than in others. Mother wavelets (db2) in the second order are used in this work as Daubechies (db2) are used in this work. In Stephane Mallat's theory of multi-decomposition [27], Fig. depicts (a) the decomposition process and (b) the synthesis phase in the process.

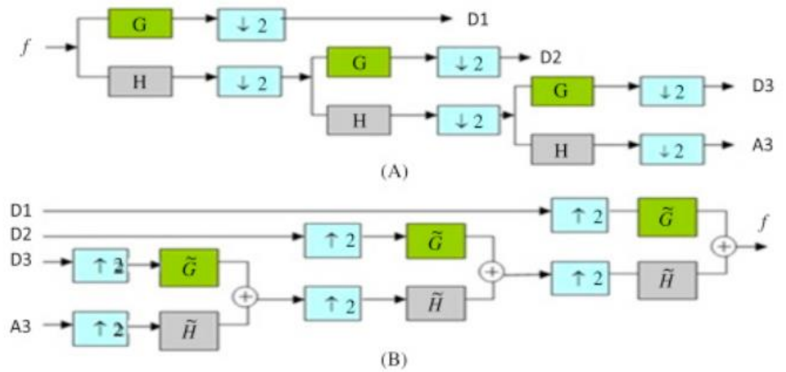


**Fig.5** phases of breakdown and composition

## III. Conclusion

A novel technique is given in this study to determine novel formula uncertain using Euler-Bernoulli Beam Vibration, wavelet spectral finite element (WSFE) four-element models are developed. The suggested identification technique combines modal forms methodology. performed show suggested approach. various places used determination scenarios. suggested Euler-Bernoulli Beam Vibration, wavelet spectral finite element (WSFE) approach offered may meet criteria concurrently. impact chosen sites, participation modalities, resultant studied.

It has been a long time since wavelets were introduced into the field. The wavelet transform is used to solve and assess issues in the field of engineering mechanical challenges. It may be used for a range of applications, including mechanical response studies to extract model parameters, sounds, damage assessments, and so on, as well as solution for mechanical system differential equations, transformation, and wave propagation issues using wavelets. Lower frequencies, such as those in the range of vibration, are the focus of structural dynamics, which involves study of a variety of subjects in addition to those mentioned above. The study of transient responses with frequencies in the Kilohertz range, on the other hand, is produced by high-frequency excitations and includes the investigation of high-frequency excitations.

Technical approaches to the resolution of structural dynamics-related issues It is possible to obtain an answer to the issue by looking at the features of the object, mainly the shapes, the modelling system loads, movement, and so on. When working with a complex system, it is common to see it linked together. This article also includes a section on wavelet analysis, but the main focus is on the wavelet-based spectrum analysis of wave propagation. A technique based on simulation is used, and the researchers have created a numerical methodology to support their findings.

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