Scale Extraction from Sin Morlet Wavelet – A New Approach

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The present piece of work is focused on scale extraction of the wavelet, deviating from the conventional wavelet transformation. The hypothesis is that the 3-D Morlet sin wavelet (3D-MSW), which is considered as a source impulse function, gets scaled while propagating through the complex heterogeneous media and is defined. The 2-D Mellin transform (TMT), a scale invariant transform, of the 3-D Morlet sin wavelet (3D-MSW) is derived both in real and complex domains. Algorithmic procedures are constructed for the extraction of quantified scale parameter from the respective real and complex domains of 2-D Mellin transformation of 3D-MSW. Since Mellin transform is restricted to 0 to ∞ it would create two hurdles 1. to know the centre position (i.e.,'t' (time) or 'x' (space) = 0) of the wavelet is a priori, and 2. half of the wave energy is ignored and as a result there is a loss of information. In order to overcome such restrictions the 2-D Fourier transform of the 3D-MSW is derived. Because the Fourier transform is essentially symmetric with respect to the zero frequency, the 2D Mellin transform of the 2D Fourier transform (2D-MFT) of the 3D-MSW is derived in real and complex domains respectively and there would be no loss of information as the entire wave energy is considered for scale analysis. Further, the algorithms are developed for the extraction of quantified scale parameters from the 2D-MFT of 3D-MSW, for real and complex domains respectively. Considering different ranges of scales, numerically simulated 3D-MSW wavelets are analyzed, using the real and complex domains of TMT and 2D-MFT algorithms and thus established the validity and robustness of algorithms. The developed 'scale extraction algorithms' could be used for different areas of data sets, viz- data compressions, nonlinear wave analysis, related to geophysics, oceanography, astrophysics, aerodynamics, satellite imageries, finger prints etc.