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Fourier analysis: graphical animation and analysis of experimental data with Excel.

Summary: According to Fourier formulation, any function that can be represented in a graph may be approximated by the "sum" of infinite sinusoidal functions (Fourier series), termed as "waves". The adopted approach is accessible to students of the first years of university studies, in which the emphasis is put on the understanding of mathematical concepts through illustrative graphic representations, the students being encouraged to prepare animated Excel-based computational modules (VBA-Visual Basic for Applications). Reference is made to the part played by both trigonometric and complex representations of Fourier series in the concept of discrete Fourier transform. Its connection with the continuous Fourier transform is demonstrated and a brief mention is made of the generalization leading to Laplace transform. As application, the example presented refers to the analysis of vibrations measured on engineering structures: horizontal accelerations of a one-storey building deriving from environment noise. This example is integrated in the curriculum of the discipline "Matemática Aplicada à Engenharia Civil" (Mathematics Applied to Civil Engineering), lectured at ISEL (Instituto Superior de Engenharia de Lisboa). In this discipline, the students have the possibility of performing measurements using an accelerometer and a data acquisition system, which, when connected to a PC, make it possible to record the accelerations measured in a file format recognizable by Excel.

Classification: M50 N50 I30 I70 U70
Keywords: Fourier series; Fourier analysis; approach; university teaching; engineering; spreadsheets; visualisation; graphical representations; movie clips in spreadsheets; spectral analysis; experimental data; trigonometric functions; sinusoidal waves; geometric interpretation of parameters; approximation; discrete Fourier transform; continuous Fourier transform; mean values; integral calculus; Fourier integrals; Laplace transform; decomposition of accelerograms into sinusoidal waves; experimental data
http://epublications.bond.edu.au/ejsie/vol5/iss2/2/