Post-processing of magnetic signals by means of Fourier, Wavelet and Hilbert-Huang Transforms.

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In any field of scientific research, data, either detected in experiments or obtained by means of numerical approaches, need to be processed to get the information they contain. One of the most important feature of scientific data is their frequency, which often becomes the first goal of data post-processing. Some numerical tools which are able to reveal the frequencies of numerical signals are the Fast-Fourier Transform (FFT), the Wavelet Transform (WT), and the Hilbert-Huang Transform (HHT), whose conception is due to the French scientist Joseph Fourier (1822), the Hungarian Alfred Haar (1910), and the Chinese Norden Huang (1998), respectively [1-3].

In this tutorial, we will see how FFT, WT and HHT can be used in the field of magnetism, with a particular reference to spintronics. The peculiarities of the three tools will be underlined, as well as different examples of application, where FFT, WT and HHT provide the frequencies of magnetic signals and, in different ways, further information about the contribution of each frequency.

[1] J.B. Joseph Fourier, *Théorie analytique de la chaleur*, Paris: Firmin Didot, père et fils, 1822.

[2] A. Haar, *Zur Theorie der orthogonalen Funktionensysteme*, Math. Ann. 69, 331–371, 1910.

[3] N.E. Huang et al., *The Empirical Mode Decomposition and the Hilbert Spectrum for Nonlinear and Nonstationary Time Series Analysis*, Proceedings of the Royal Society of London A. 454-1971: 903–995, 1998.