Fourier Transformation

Any periodic wave can be constructed as a sum of sine and cosine waves. The free induction decay, FID, in NMR is a combination of all the line frequencies in the corresponding NMR spectrum.

Fourier series: \( f(t) = \sum_{n=0}^{\infty} A_n \cos(2\pi n \nu_o t) + \sum_{n=0}^{\infty} B_n \sin(2\pi n \nu_o t) \)

with \( \nu_o = \) lowest frequency \( = 1/L \). \( L \) is the period.

To find the Fourier coefficients use:

\[ A_n = 2 \int_{0}^{L} f(t) \cos(2\pi n \nu_o t) \, dt \quad B_n = 2 \int_{0}^{L} f(t) \sin(2\pi n \nu_o t) \, dt \]

The FID has Fourier coefficients at 1 and 2 kHz, but not 3 kHz. The spectrum from the FID: