



Magic Number of Points and the IFFT

When performing the inverse FFT, the input is always complex, but the result may be either real or complex.

Because versions of Igor prior to 3.0 only allowed an integral power of two (2^n) to be forward-transformed, Igor could tell from the number of points in the forward-transformed wave what kind of result to create for the inverse transform. To ensure compatibility, Igor versions 3.0 and after continue to treat certain numbers of points as “magical.”

If the number of points in the wave is an integral power of two (2^n), then the wave resulting from the IFFT is complex. If the number of points in the wave is one greater than an integral power of two ($1+2^n$), then the wave resulting from the IFFT is real and of length (2^{n+1}).

If the number of points is not one of the two magic values, then the result from the inverse transform is real unless the complex result is selected in the Fourier Transforms dialog.

Changes in X Scaling and Units

The FFT operation changes the X scaling of the transformed wave. If the X-units of the transformed wave are time (s), frequency (Hz), length (m), or reciprocal length (m^{-1}), then the resulting wave units are set to the respective conjugate units. Other units are currently ignored. The X scaling's X_0 value is altered depending on whether the wave is real or complex, but dx is always set the same:

$$\Delta x_{FFT} = \frac{1}{N \cdot \Delta x_{original}} \quad \text{where, } N \equiv \text{original length of wave}$$

If the original wave is real, then after the FFT its minimum X value (X_0) is zero and its maximum X value is:

$$\begin{aligned} x_{N/2} &= \frac{N}{2} \cdot \Delta x_{FFT} = \frac{N}{2} \cdot \frac{1}{N \cdot \Delta x_{original}} \\ &= \frac{1}{2 \cdot \Delta x_{original}} \\ &= \text{Nyquist Frequency} \end{aligned}$$

If the original wave is complex, then after the FFT its maximum X value is $X_{N/2} - dX_{FFT}$, its minimum X value is $-X_{N/2}$, and the X value at point $N/2$ is zero.

The IFFT operation reverses the change in X scaling caused by the FFT operation except that the X value of point 0 will always be zero.