DSB Portfolio 1

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2. november 2010

1 Draw the double sided spectrum of the amplitudes for the signal x(t)

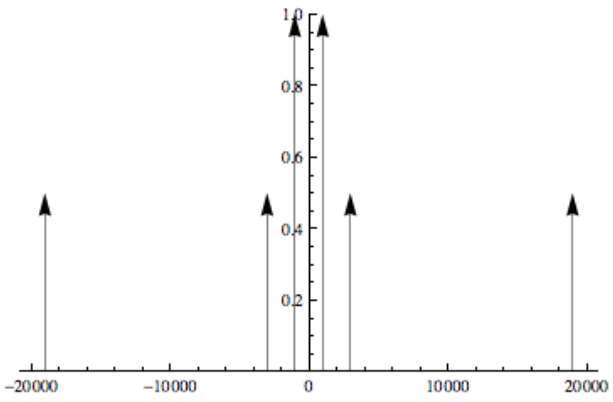
By using Eulers princible $x(t)$ can be rewritten as:

$$\begin{aligned} x(t) &= 2 \cdot \frac{e^{i2\pi \cdot 1000t} + e^{i2\pi \cdot 1000t}}{2} + \frac{e^{i2\pi \cdot 3000t} + e^{i2\pi \cdot 3000t}}{2} + \frac{e^{i2\pi \cdot 19000t} + e^{i2\pi \cdot 19000t}}{2} \\ x(t) &= e^{i2\pi \cdot 1000t} + e^{i2\pi \cdot 1000t} + \frac{1}{2} \cdot e^{i2\pi \cdot 3000t} + \frac{1}{2} \cdot e^{-i2\pi \cdot 3000t} + \frac{1}{2} \cdot e^{i2\pi \cdot 19000t} + \frac{1}{2} \cdot e^{-i2\pi \cdot 19000t} \end{aligned} \tag{1}$$

Which gives us the coefficients:

$$\begin{aligned} c_1 &= 1 \\ c_{-1} &= 1 \\ c_3 &= 0,5 \\ c_{-3} &= 0,5 \\ c_{19} &= 0,5 \\ c_{-19} &= 0,5 \end{aligned} \tag{2}$$

And the double sided spectrum:



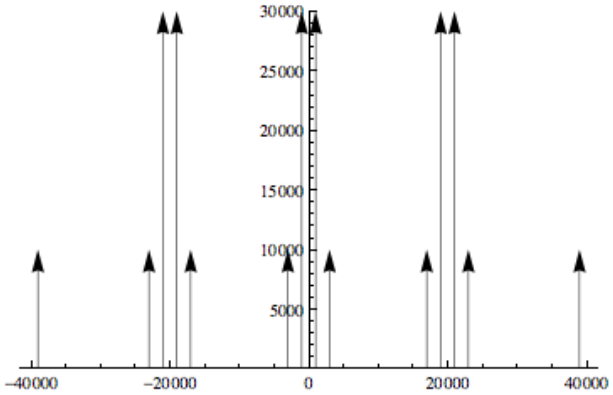
Figur 1: Double Sided Spectrum without aliasing

2 Draw the double sided spectrum xs1(t) for the sampled signal without the anti-aliasing filter

The samplerate of the A/D-converter is 20kHz. The new coefficients will be calculated by by multiplying them with the samplerate. Which gives:

$$\begin{aligned} c_1 &= 20000 \\ c_{-1} &= 20000 \\ c_3 &= 10000 \\ c_{-3} &= 10000 \\ c_{19} &= 10000 \\ c_{-19} &= 10000 \end{aligned} \tag{3}$$

And a plot of the double sided spectrum:



Figur 2: Double Sided Spectrum with aliasing