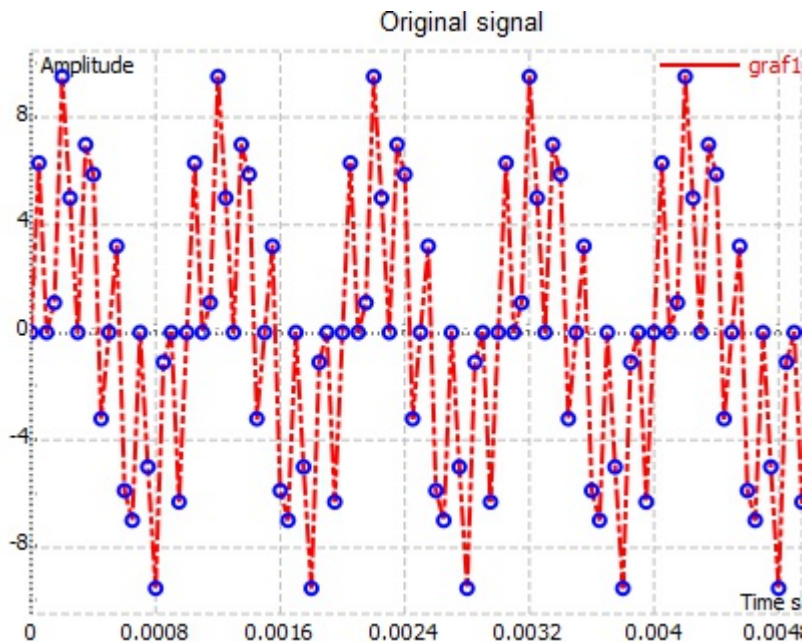


Signal Interpolation - Upsampling

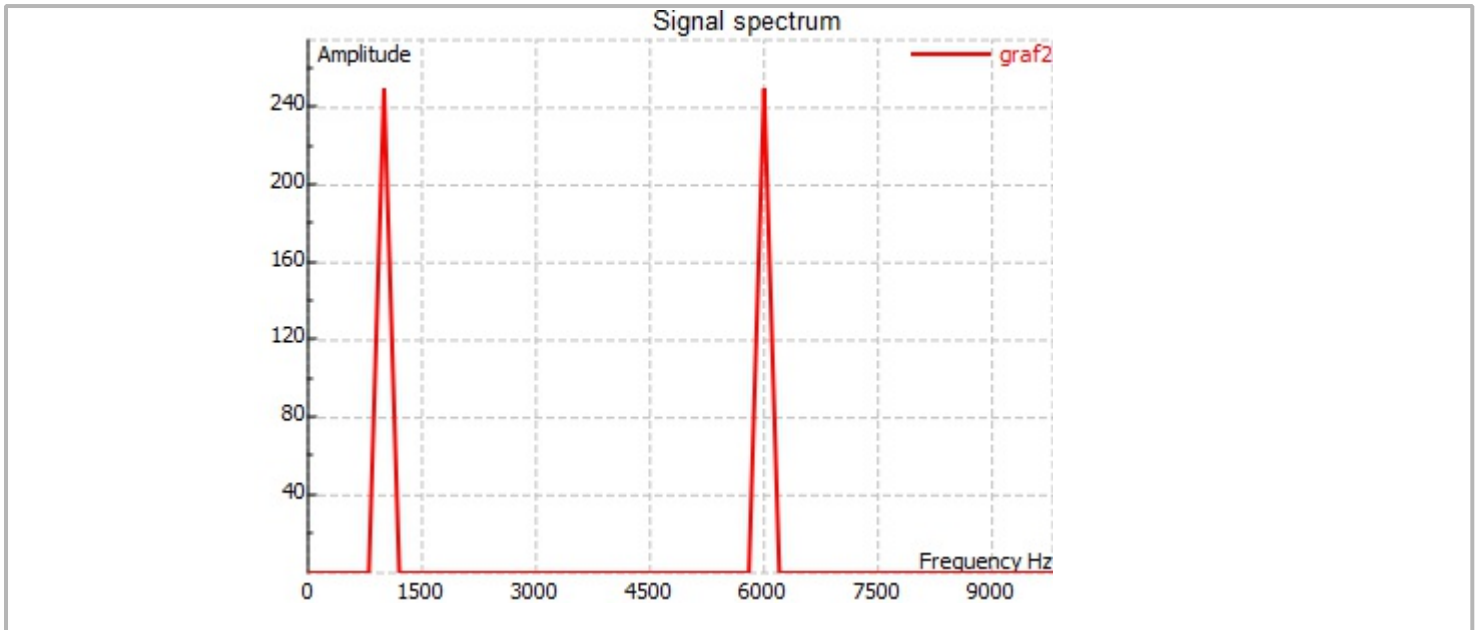
This example we illustrate the process of signal interpolation using existing MatDeck functions. The interpolation is the increase of the sampling rate. First, the test signal is generated. We use the sum of two sinusoidal signals of different frequencies.

```
Fs:= 20000    Hz, original sampling rate
Ts:= 1/Fs     Sampling period
Dt:= curve2d(x, 0, 0.005 - Ts, 100)    Time axis
dt:= col2vec(Dt, 0)
f1:= 1000    Hz, frequency of the first sinusoidal signal
f2:= 6000    Hz, frequency of the second sinusoidal signal
y:= 5 sin(2 π · f1 dt) + 5 sin(2 π · f2 dt)    The input test signal, sum of two sinusoidals
graf1:= join mat cols(dt, y)    Time domain graph of the test signal
```



We can investigate the signal spectrum as well. We determine the spectrum by using fft.

```
nfft:= size(y)    Length of the input signal
fy:= fft1(y)     Spectrum of the input signal
fy1:= subset(fy, 0, 0, nfft/2 - 1, 0)    Only half of the periodic spectrum is taken due to symmetry
xfft:= curve2d(x, 0, (Fs/2) · (nfft/2 - 1) / (nfft/2), 50)    Frequency axis
xfft1:= col2vec(xfft, 1)
fyy1:= |fy1|     Amplitude spectrum of the input signal
graf2:= join mat cols(xfft1, fyy1)    Graph of the amplitude spectrum of the test signal
```

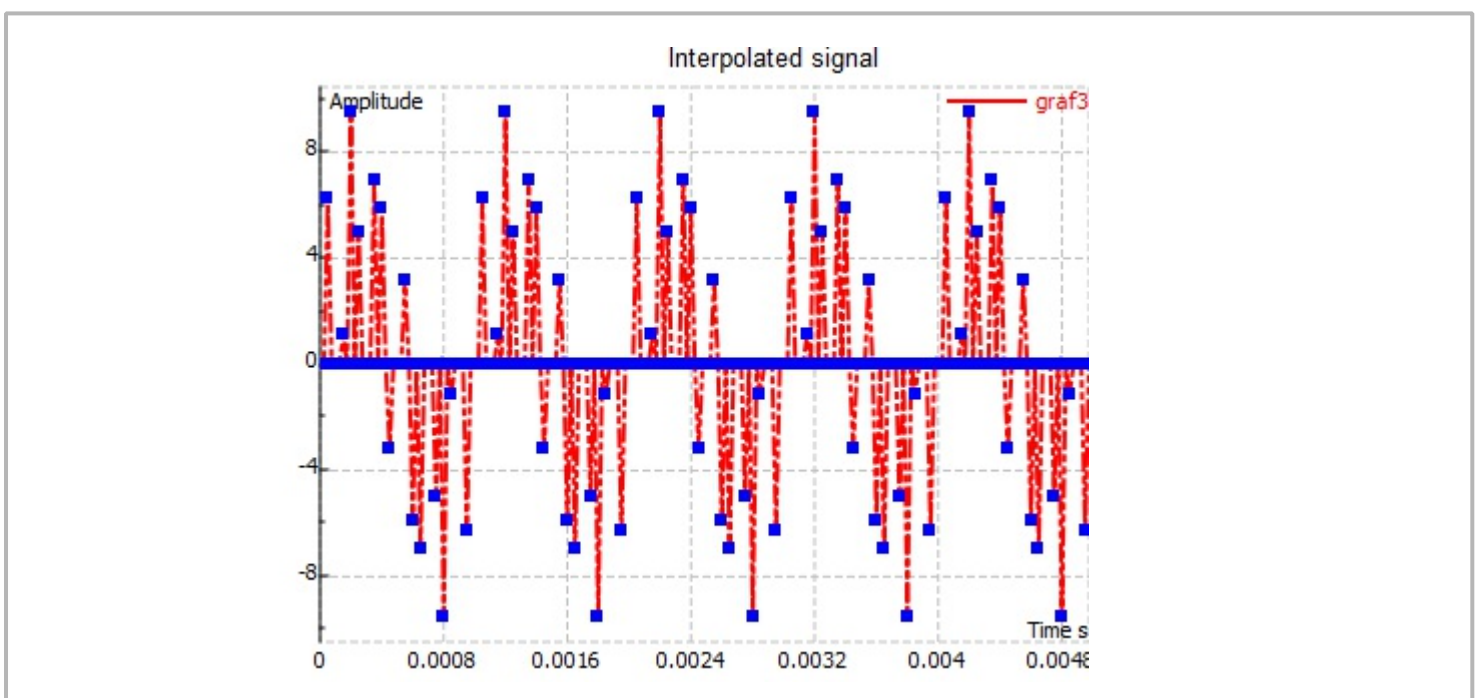


The following task is to increase the sampling rate by a factor of two, increasing the number of samples. When interpolation is performed, one should take care about proper timing, in order to illustrate the decimation.

```

N:=2    Upsampling factor
yinter:=upsample(y , N)    Upsampled signal
Fs1:=Fs N    New sampling rate
Ts1:= 1/Fs1    New sampling period
Dt1 := curve2d(x , 0 , 0.005 - Ts1 , 200)    New time axis
dt1 := col2vec(Dt1 , 0)
graf3:=join mat cols(dt1 , yinter)    Graph of the upsampled signal

```



We can analyze the frequency spectrum of the interpolated signal

```
nfftd := size(yinter)    Size of the upsampled signal
fyinter := fft1(yinter)  Spectrum of the upsampled signal
fy1d := subset(fyinter, 0, 0, nfftd/2-1, 0)  Only half of the periodic spectrum is taken due to symmetry
xfttd := curve2d(x, 0, (N Fs/2) * (nfftd/2-1)/(nfftd/2), 100)  New frequency axis
xft1d := col2vec(xfttd, 1)
fyy1d := |fy1d|  Amplitude spectrum of the upsampled signal
graf4 := join mat cols(xft1d, fyy1d)  Graph of the amplitude spectrum of the upsampled signal
```

