Multi-Trend Signal

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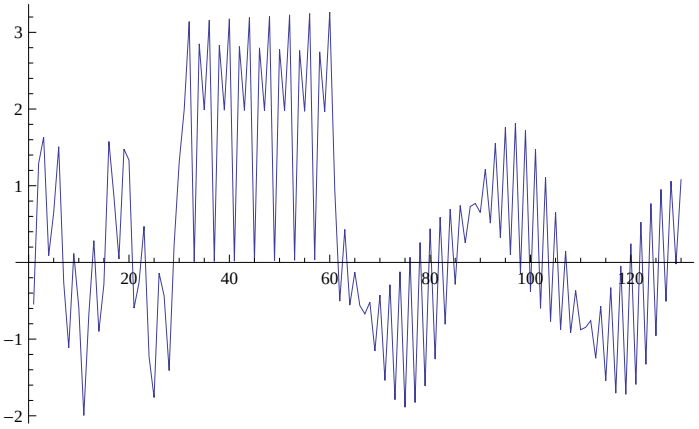
Signal:

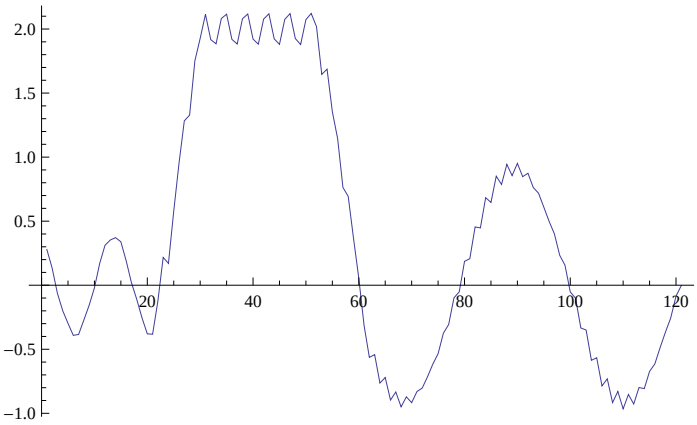
$$\begin{cases} \text{Sin}[13*n] + \text{Sin}[17*n] & n \le 30 \\ 2 + (-1)^n + \text{Sin}[11*n] & 30 < n \le 60 \\ \text{Sin}[19*n] + \text{Sin}[3*n] & 60 < n \end{cases}$$

Composed of superposition of other periodical sub-signals, with high amplitude sub-bands of low frequencies.



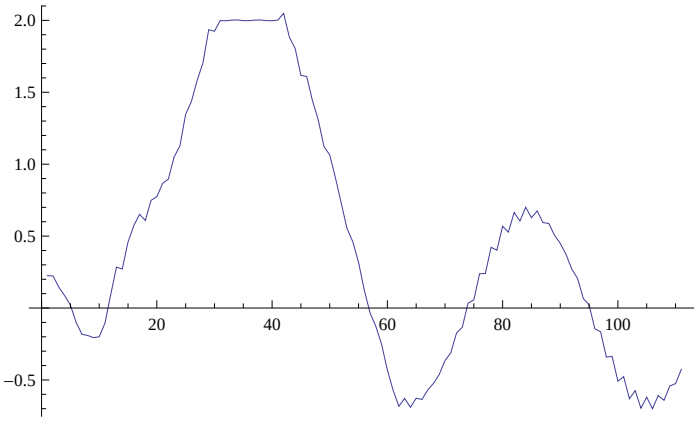
As you can see the moving average dulls (over-smoothes) the periodical sub-signals.

Moving Average Filter, window = 10:

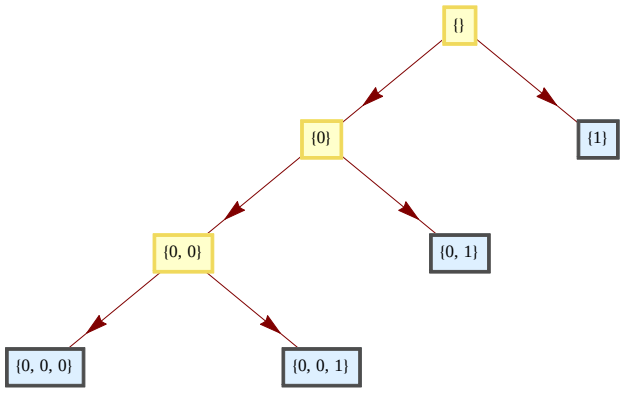


Larger window sizes smoothes the signal even further to the point that original shape is lost.

Moving Average Filter, window = 20:

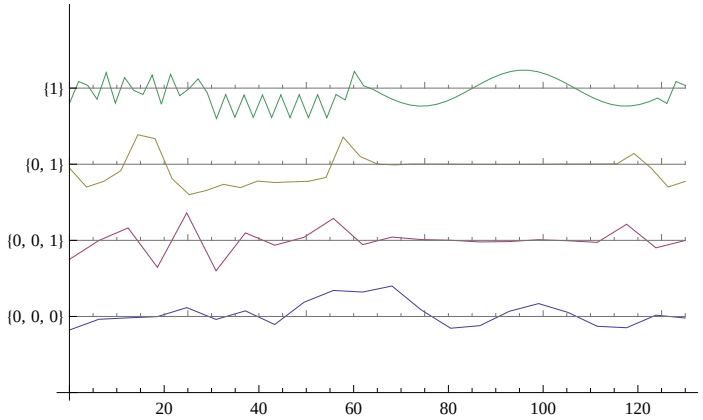


Using Daubechies Wavelet [4] we break the signal into 4 refinements (sub-signals):

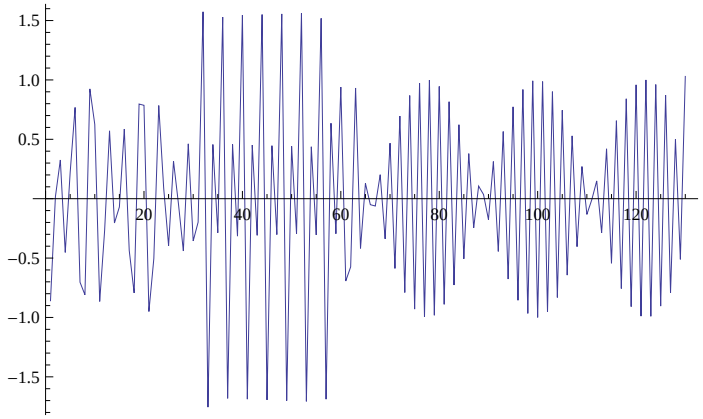


Note that each each refinement has high amplitude of decomposition:

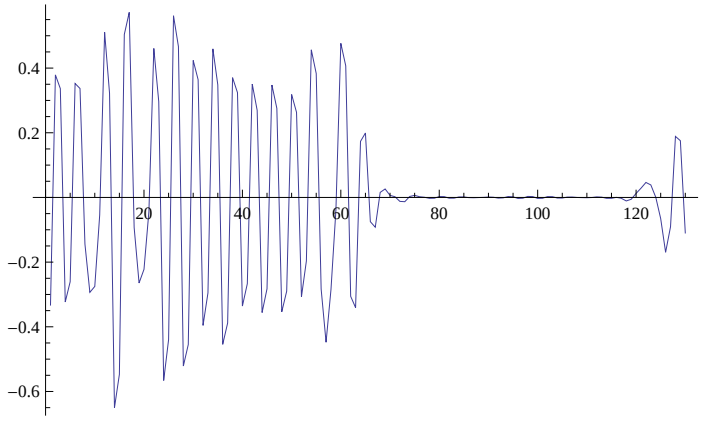
Out[216]= {{1} → 0.311944, {0, 1} → 0.0363368, {0, 0, 1} → 0.0594871, {0, 0, 0} → 0.592232}



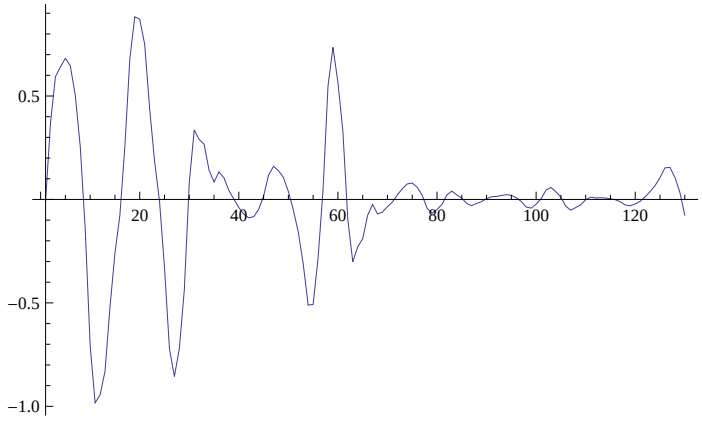
{1}



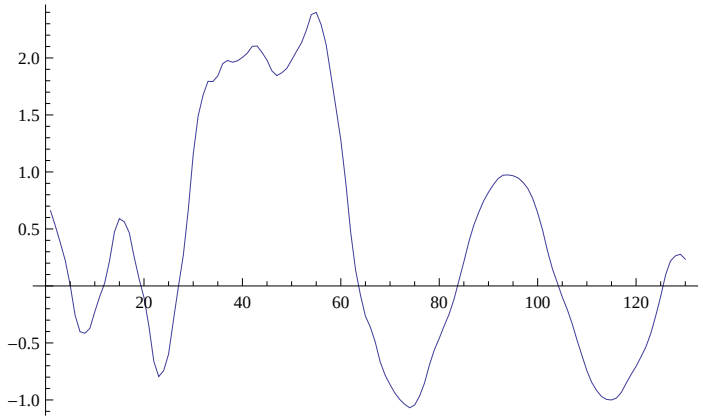
{0,1}



{0, 0, 1}



{0, 0, 0}: Similar to moving average



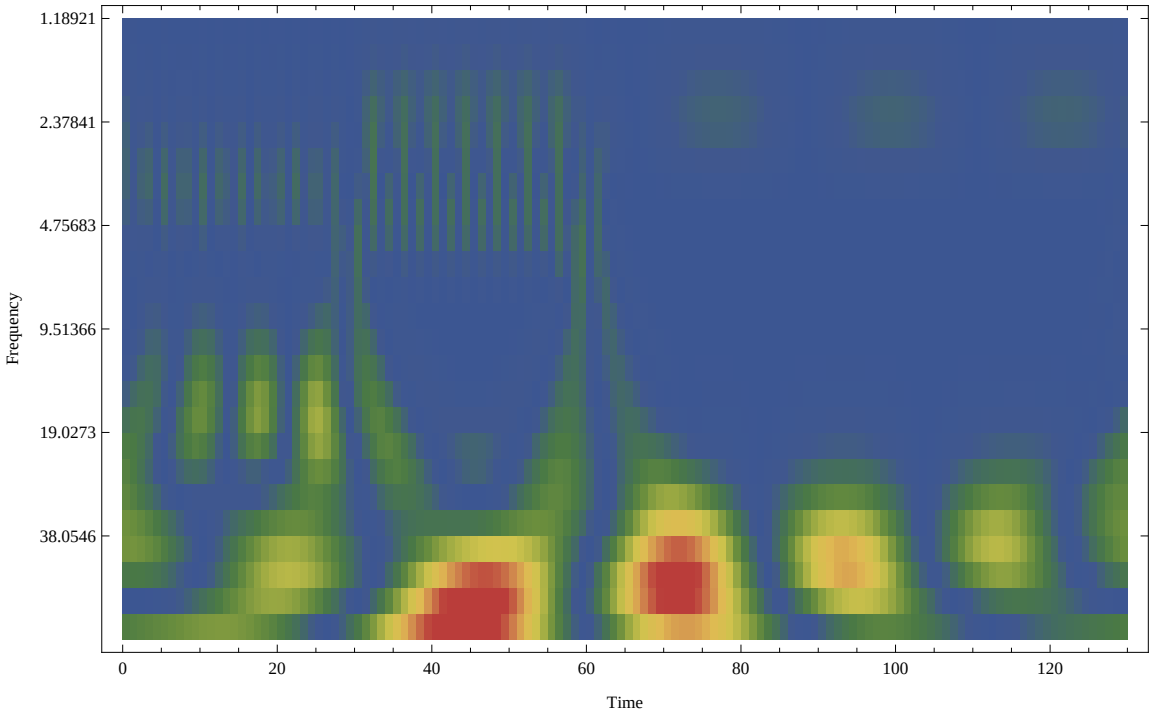
Scalograms

DGaussian Wavelet [4], no padding.

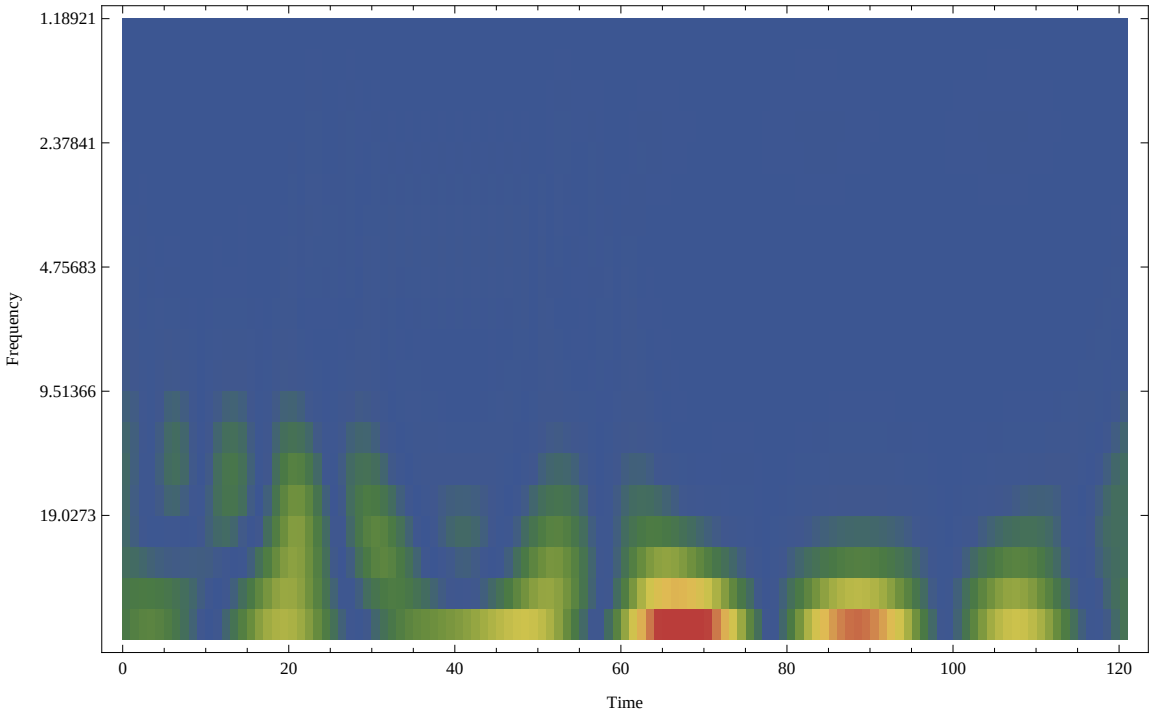
Color Scheme: Blue Min, Red Max

Original signal:

Note the frequency ranging around 2 (y-axis) before 60 (x-axis) due to $(-1)^n$ sub-singal, you see 11-17 (y-axis) for x-axis values less than 30 due to Sin[$13*n$] + Sin[$17*n$] :



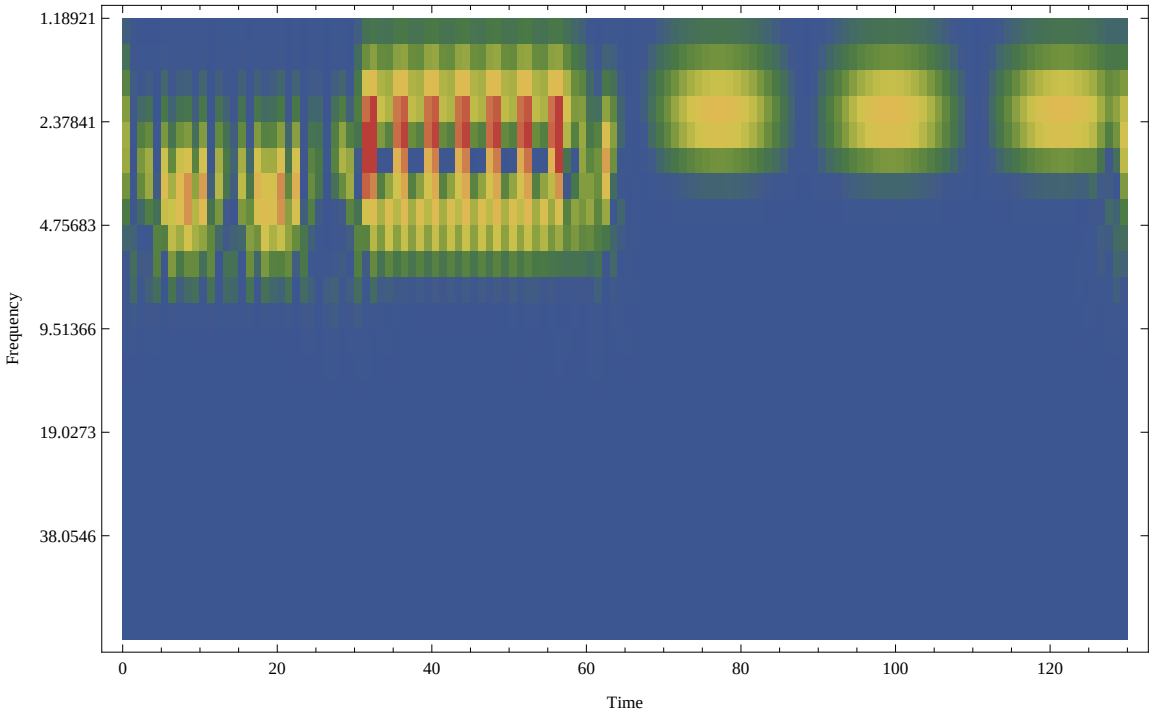
Moving Average Filter, window = 10:



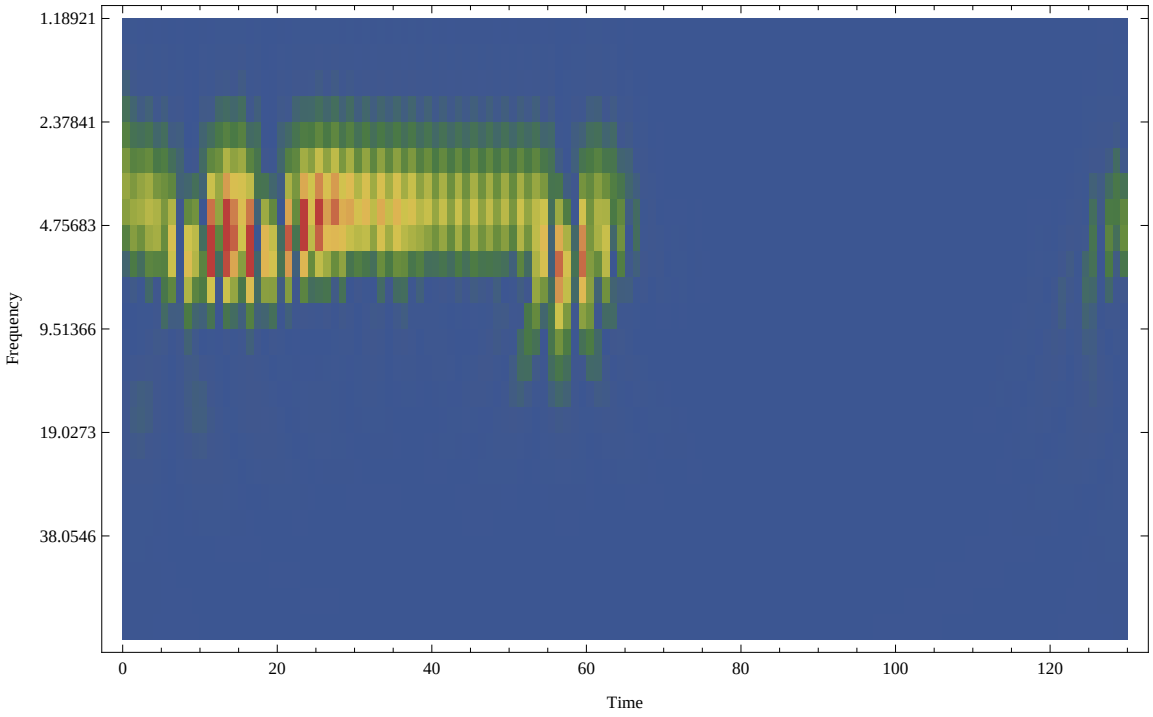
As you can see most of the higher frequencies are deleted from by means of the averaging sliding window.

Let’s look at the Scalograms for each refinement level and its decomposed signal:

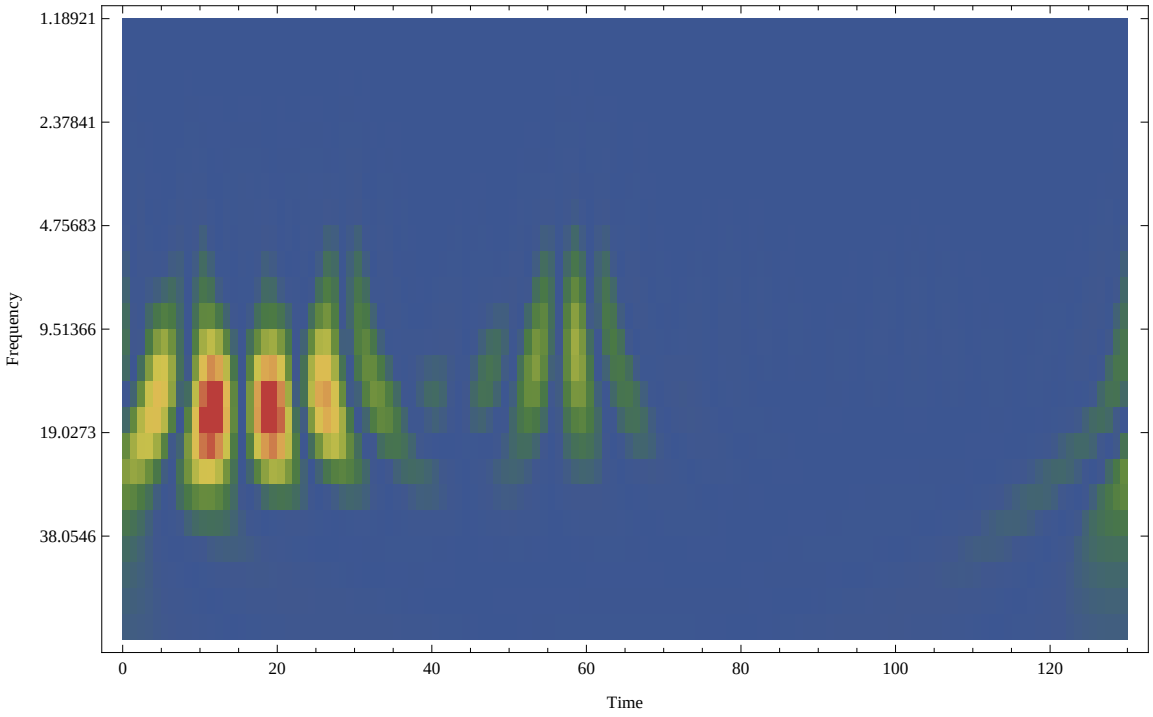
{1}



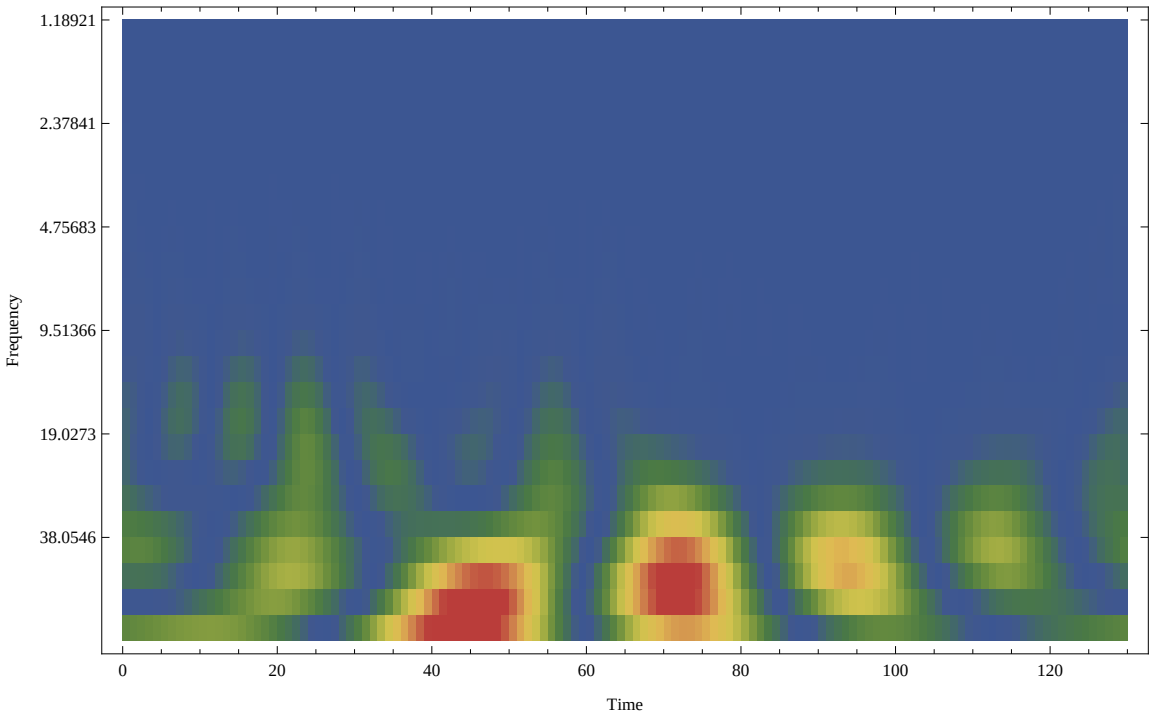
{0, 1}



{0, 0, 1}



{0, 0, 0} : quite similar to the moving average :


1.18921
2.37841
4.75683
9.51366
19.0273
38.0546
Frequency
0
20
40
60
80
100
120
Time