Problems with DEMA

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14-Dec-2003

Introduction

The problem with moving averages is that they don't seem to respond as people think that they should, and consequently they can appear to give false triggers. Clinically, the reasons are pretty clear in that exponential moving averages are in fact 1st order responses, and they inherently respond to a step excitement as an exponential decay, and that is exactly what IIR filters do – specially those that are to date used in technical analysis.

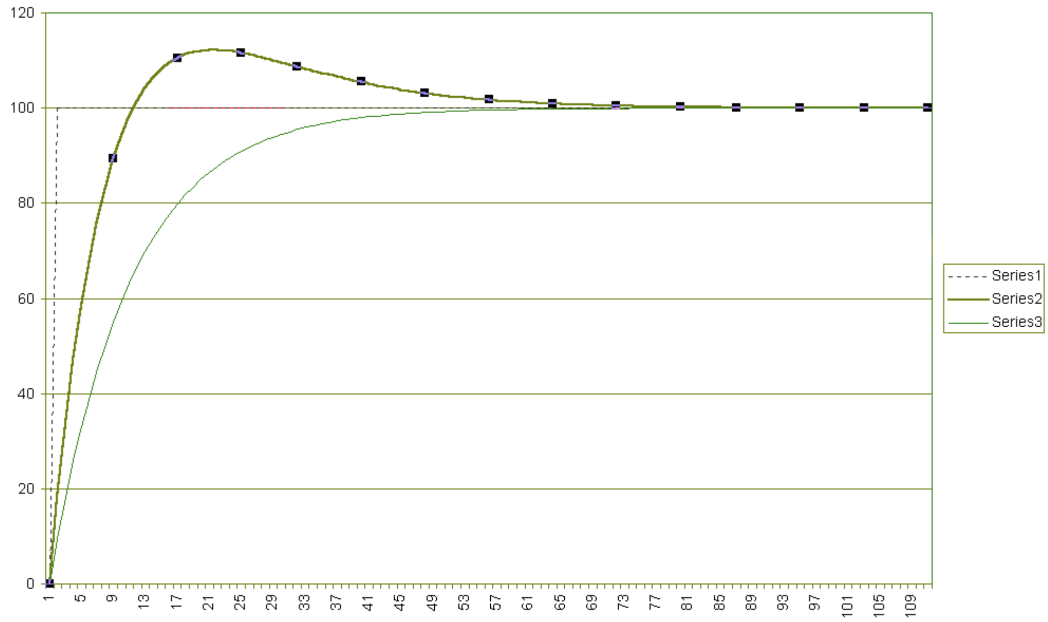
The Double Exponential Moving Average (DEMA) and Treble Exponential Moving Average (TEMA) indicators were developed by Patrick Mulloy and introduced in the Technical Analysis of Stocks & Commodities magazine in the February 1994 edition.

Until now, I had always treated the Double Exponential Moving Average (DEMA) etc with some degree of concern, mainly because the equation for a DEMA is a variation on a 1st order EMA, and as such it is eventually still a 1st order EMA. It goes like this (for 20 periods):

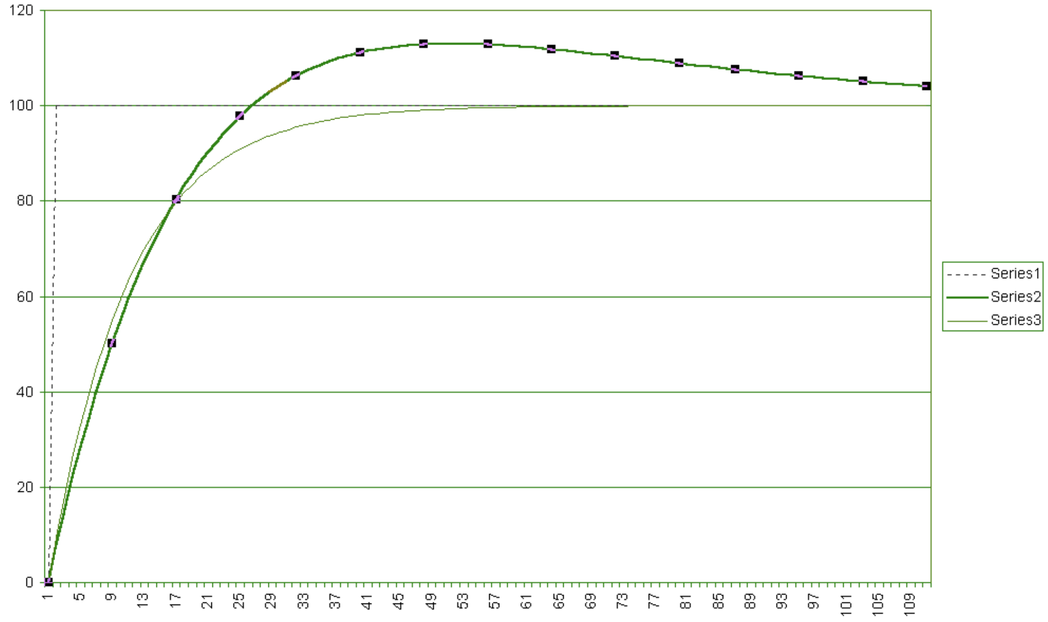
DEMA20 = 2 x EMA(Price, 20) - EMA(EMA(Price, 20), 20)

This reads, as the DEMA based on 20 periods is two times the EMA based on 20 periods minus the EMA of the EMA based on 20 periods, for 20 periods. In other words the negative correction factor appears like a partial derivative of the first moving average – hence my concern, because it is an exponential based on a common time reference!

Before we start comparing the DEMA to the EMA, a reference EMA needs to be established and put on every graph. In all cases here, the reference excitation (input) is a 100-unit step function (dotted line) and the output reference is EMA20 (the thin line). The resultant DEMA is the thick line with dots on it!



The graph above shows a DEMA20 against the reference EMA20 and clearly, the DEMA20 has a much faster rise time than the EMA20 and this needs to be 'normalised', so that its 80% point intersects with the reference EMA20. The graph below shows the DEMA time constants multiplied out by 2.5 time constants to get this normalisation.



Normalising the DEMA

Now, the above graph (DEMA20) overshoots by about 12%, and this is another concern. Now we have a real comparison, and this means that the "normalised DEMA" includes a time constant correction factor of 2.5 times for its periods to align with a comparative moving average.

So the "normalised DEMA20" will now read:

Normalised DEMA(Period) = 2 x EMA(Price, (2.5*Period))

- EMA(EMA(Price, (2.5*Period)), (2.5*Period))
-
-

And in the case of the Period being 20 then the normalised equation would be:

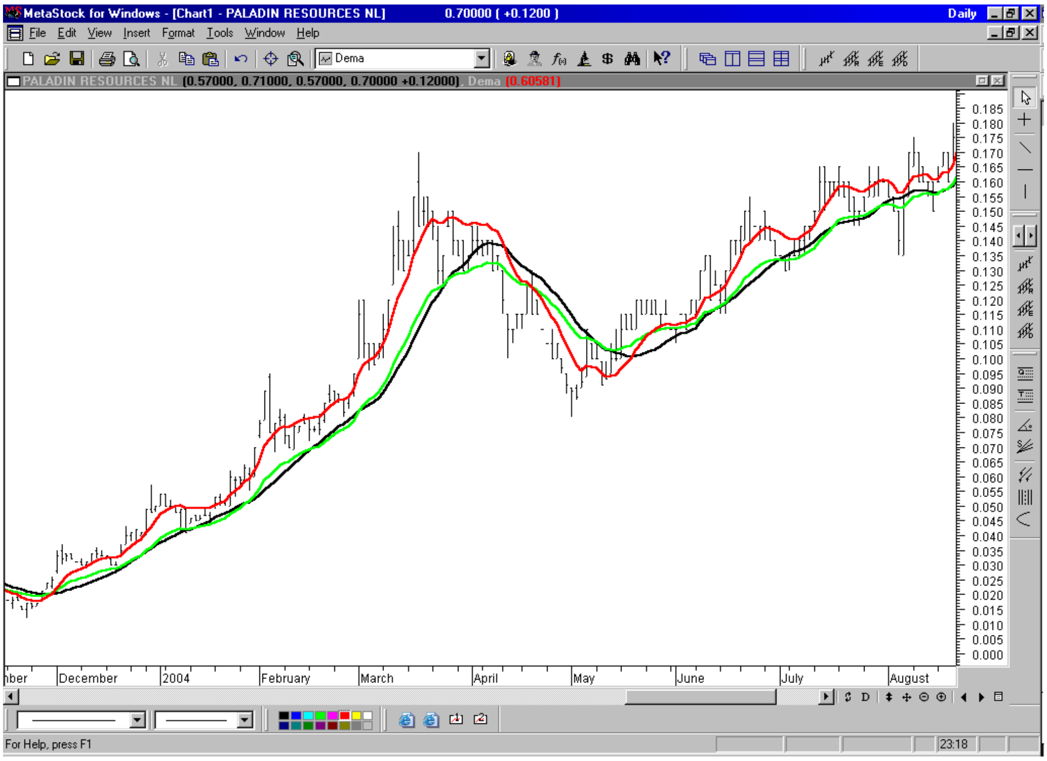
Normalised DEMA20 = 2 x EMA(Price, 2.5*20) - EMA(EMA(Price, 2.5*20), 2.5*20)

Normalised DEMA20 = 2 x EMA(Price, 50) - EMA(EMA(Price, 50), 50)

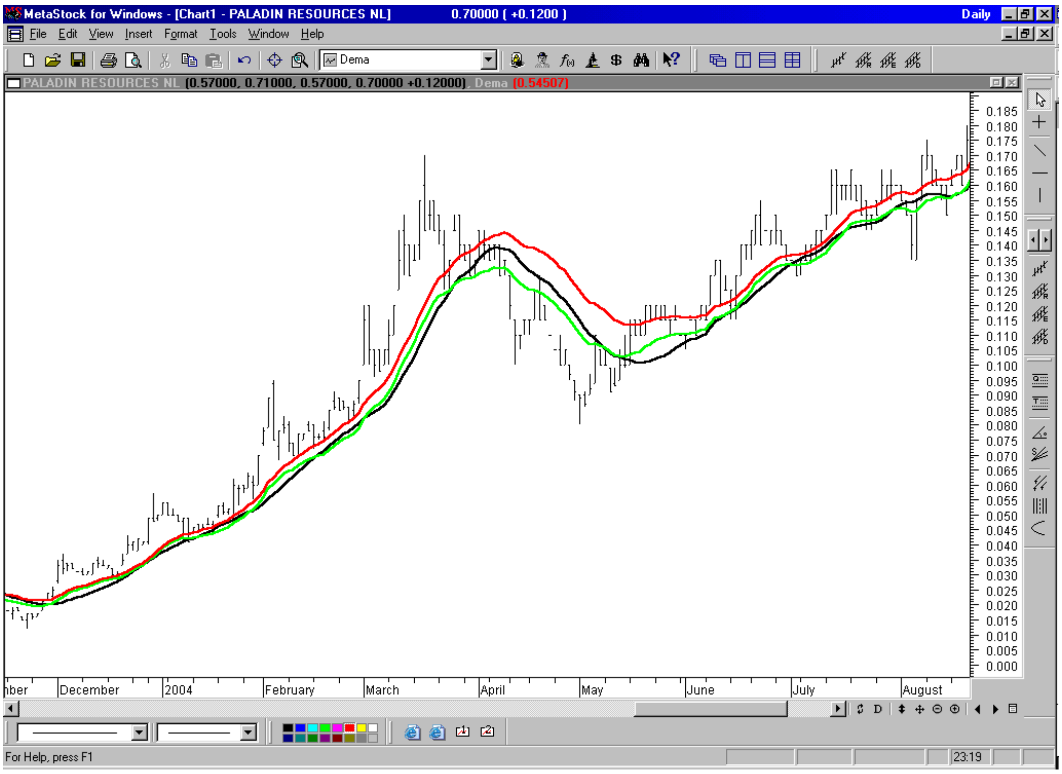
Comparing the SMA, EMA and Normalised DEMA

To get an appreciation of how the "normalised DEMA20" compares with a SMA20 and an EMA20, in real life with EOD data shows what happens, and the peak near the centre of the graphs tells us a lot.

The graph below shows the DEMA20 in direct comparison to the SMA20 and EMA20. In this case the DEMA20 is in Red, really hugs the prices, peaks much earlier and higher, crosses over the SMA20 (black) and EMA20 (green) and then crosses up before hugging the prices again. Clearly the time constant is wrong (too short) for the DEMA as the red moving average line should largely concur with the other two moving averages.

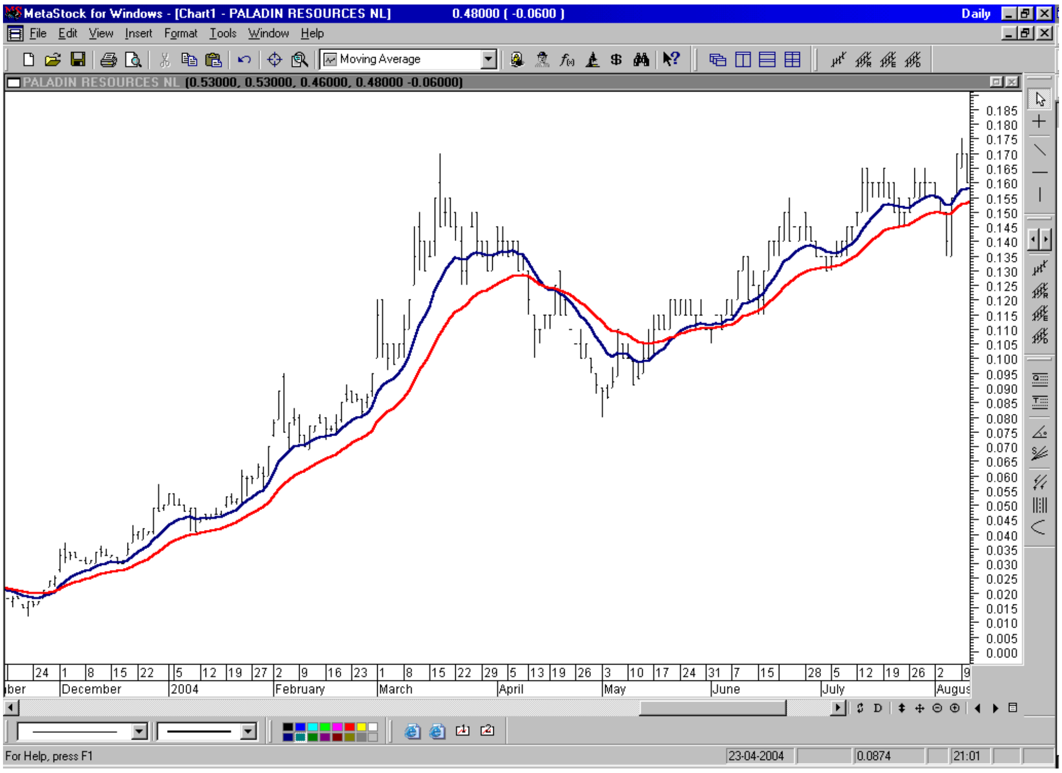


In the graph below, the DEMA20 has been "normalised" by 2.5, and it aligns with the EMA20 and SMA20. The Normalised DEMA also overshoots and consequently fails to pull down into the trough. Clearly the overshoot is a major problem here, as the DEMA takes too long to settle.

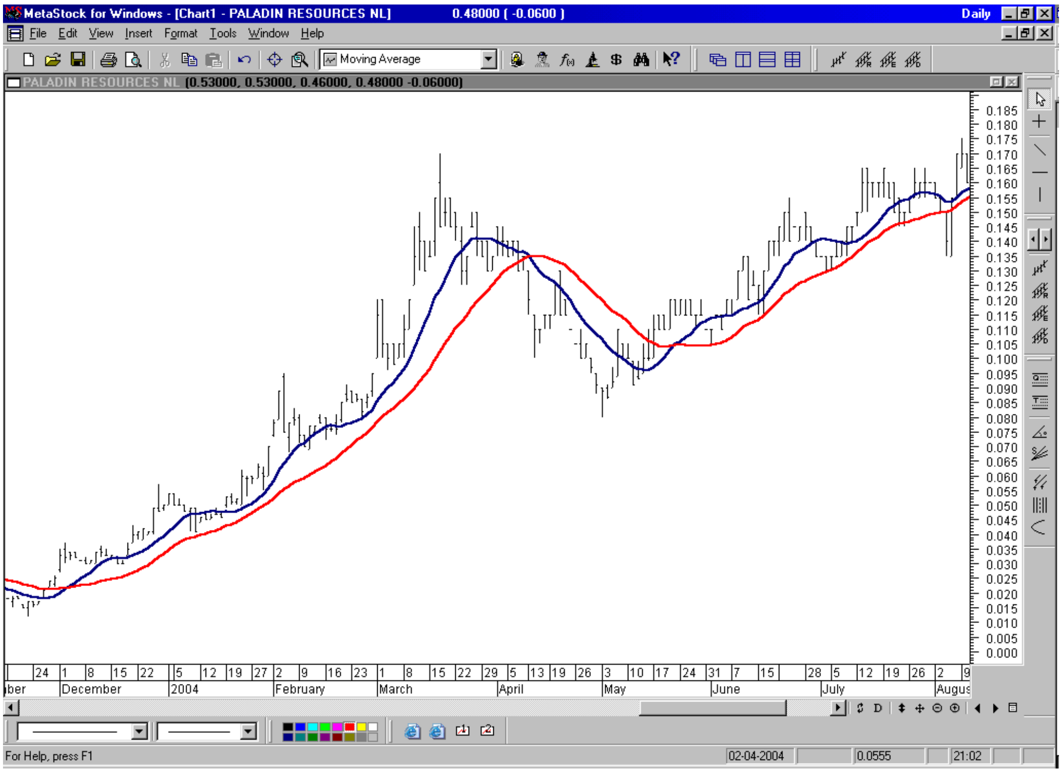


It is wise to also get the nomenclature aligned before proceeding! In the initial stages the DEMA was not normalised so a DEMA20 meant that the periods were based on 20 in this case. In being normalised a factor of 2.5 slowed the DEMA to align with EMA and SMA periods, so a "normalised DEMA20" was in fact a "DEMA50".

Looking a little closer using the "normalised DEMA" in comparison to the EMA and SMA for crossing over, the following graphs give a good picture:

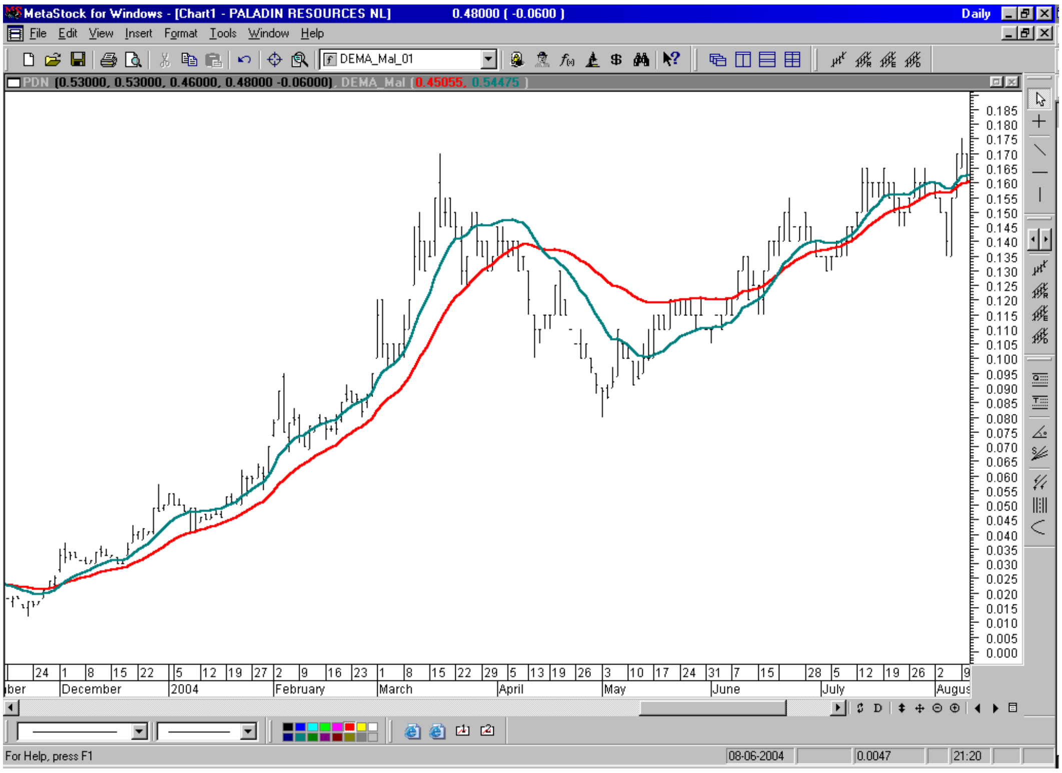


The above graph contains two exponential moving averages EMA12 and EMA26.

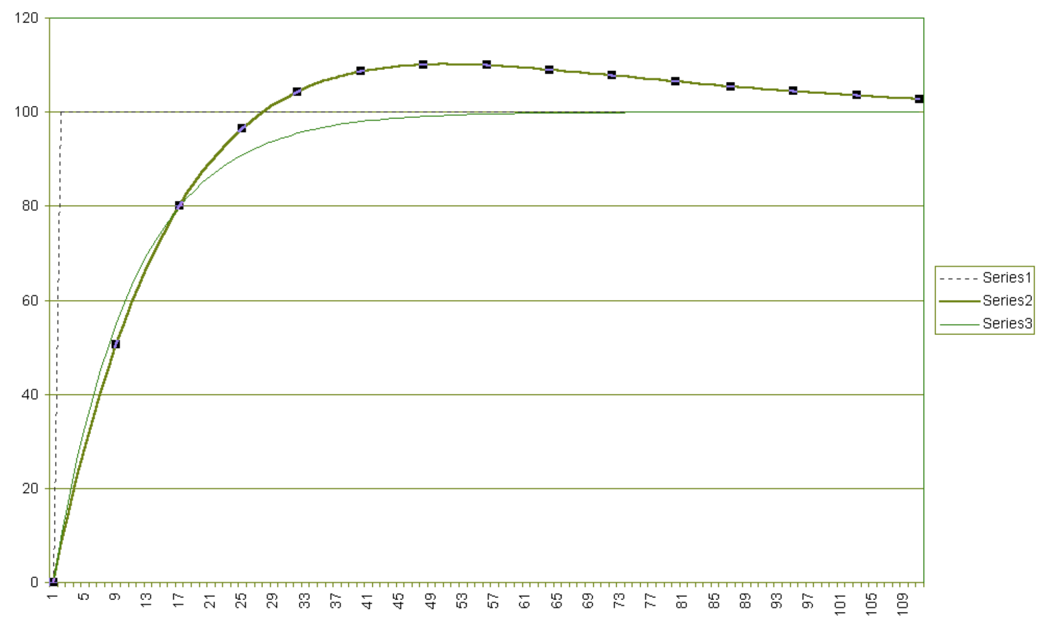


In the above graph are two simple moving averages using SMA12 and SMA26. Note the crossing SMA is much "cleaner" than the EMA in the chart above this one. The EMA pair in the top graph has trailing tails that are caused by the recursive nature of the EMA filter transient response.

The left hand graph below is of a "normalised DEMA12" (DEMA30) and "normalised DEMA26" (DEMA65). Note that the first crossover is clean but the second crossover is very late and smeared, and this is because of the extended DEMA tails. Ideally the DEMA would be far better if the exponential tail was significantly shortened.



The graph below shows this tail, and it clearly explains why the DEMA takes so long to settle. While the rise Time may be far straighter, the settling time far exceeds that of the basic EMA low pass filter.

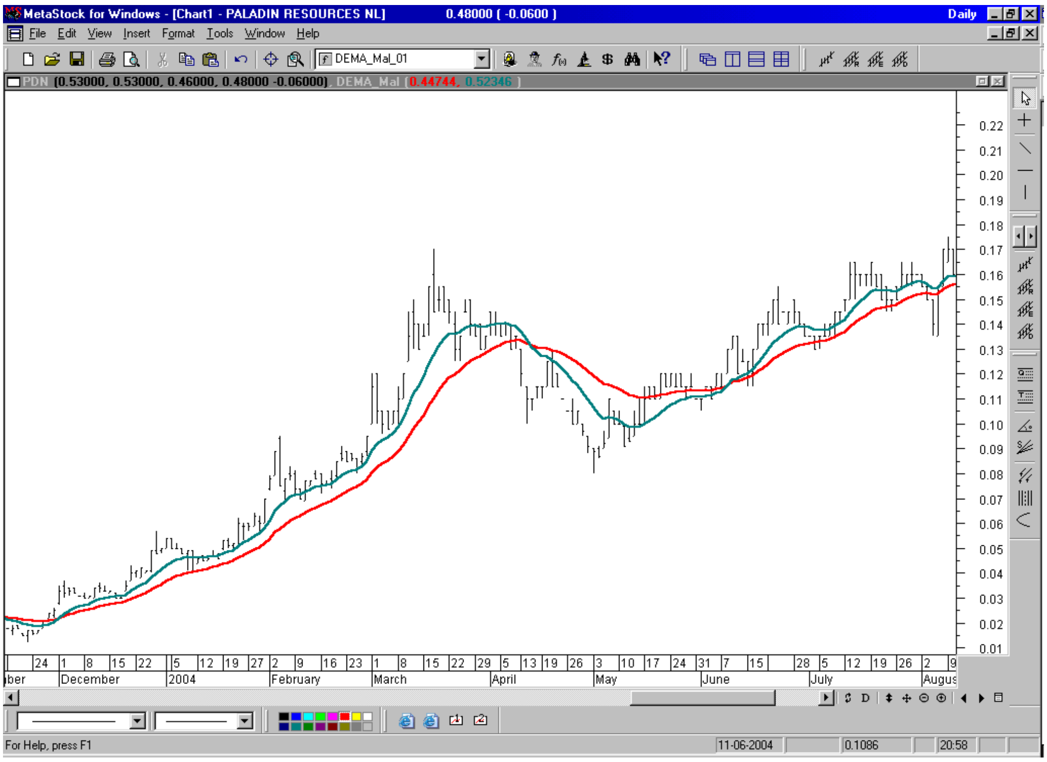


As shown before, in the immediate graph above, the basic DEMA overshoots by about 12% and then has a tail that takes far too long to settle. Anybody who has worked with TVs and monitors is aware that an overshoot is due to undercompensation in the video stages and this leads to “smearing” of the picture on the screen – and that is what is happening here too!

It is now time to move on and see what improvements can be introduced to the DEMA to make it a better indicator! By leaving the DEMA coefficients at 2, 1 and by individually adjusting each EMA percentage coefficients, some significant changes are possible, but again the nomenclature needs to be made clear, as there are now two different EMA values, and they can be written as follows:

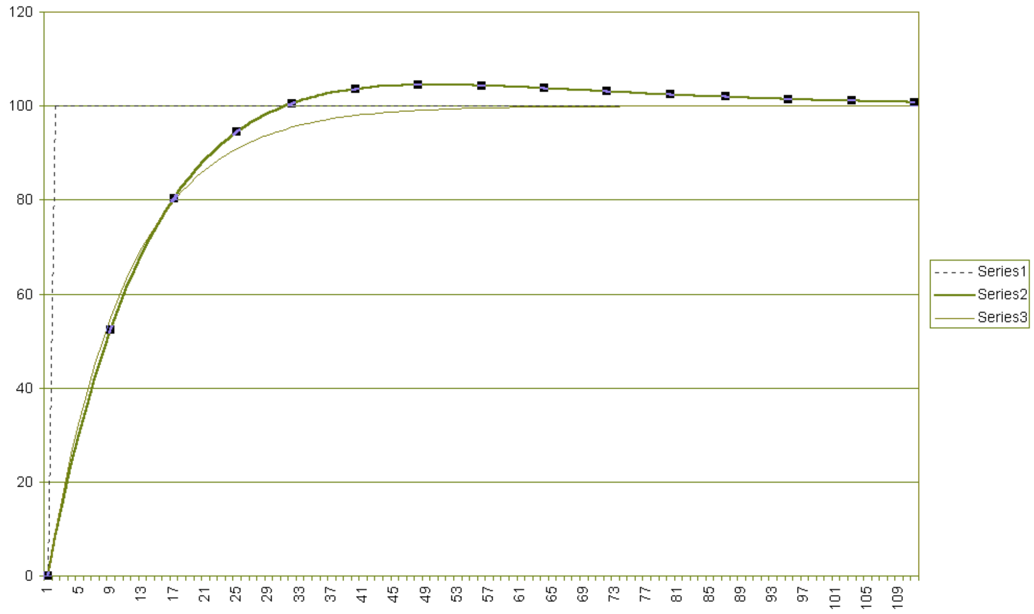
DEMA45_32 = 2 x EMA(Price, 45) - EMA(EMA(Price, 45), 32)

In this case, this DEMA approximates the same risetime to 80% that an EMA20 does, but it has only a 4.5% overshoot compared to the 12% overshoot typical of the basic DEMA (and a long tail). A slight adjustment of the second EMA value to 30, that is DEMA45_30 brings the overshoot back to about 3.0%. The practical and clinical results are shown below:

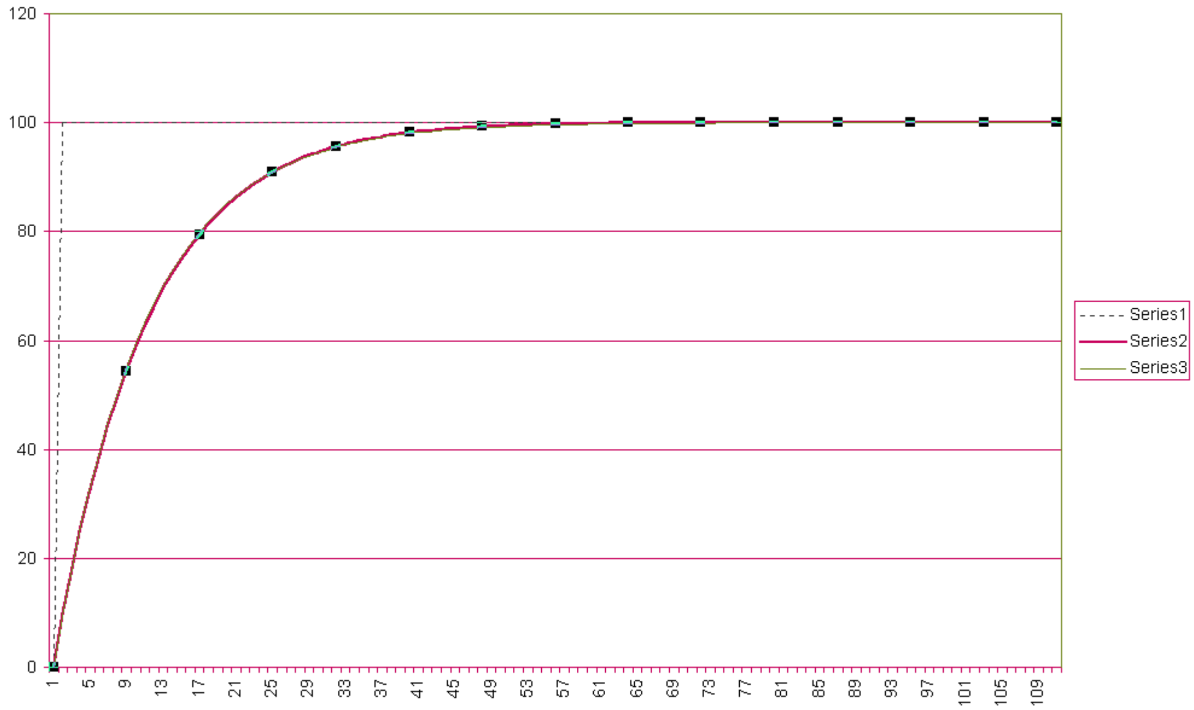


In the graph above the two crossing DEMA, (normalised to align with EMA12, EMA26) are in fact a DEMA27_19 and DEMA58_42. Again the first crossover is clean and the second is late and smeared. Clearly overshoot and the long tail of these indicators is a problem that needs attention. The SMA is still the clear winner here in all these!

The graph below shows the clinical results of producing the DEMA58_42 and progressively the overshoot is being pulled down while the rise time gets progressively more like a standard EMA.



Further adjustment comes up with the DEMA40_21 being extremely close to EMA20. The (normalised or otherwise) DEMA simply does not work because the overshoot is excessive and the tail is too long and unwieldy (but don't tell anyone)! The un-normalised DEMA gives misleading optimistic results because it is 2.5 time constants too quick in direct comparison to an SMA or EMA! Let's go a little further.



Now I am reasonably sure that effectively, the DEMA does not work.

[Comments and Corrections are welcome]