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TAOTN 2002

John Ehlers

- Pioneer of MESA studies
- FuturesTruth has ranked his S&P, Bond, and Currency trading systems #1
- Winner 27 Readers' Choice Awards from Stocks & Commodities magazine
- Author of MESA and Trading Market Cycles
- Author of Rocket Science for Traders

Agenda

- Theory
  - Random Walk and the Basis for Market Modes
  - Basic Tools - Averages and Momentums
- How MESA Trades the Market Modes
- How MESA can make good indicators better by making them adaptive
- Fisher Transform
  - How to enhance your current indicators

Drunkard's Walk

- I relate the market to known physical phenomena
  - Smoke plume for Trend Modes
  - Meandering river for Cycle Modes
- Both randomness and short term cycles can arise from the solution to the random walk problem
- Solution is the "Diffusion Equation" for Trend Modes
- Solution is the "Telegraphers Equation" for Cycle Modes

Diffusion Equation

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- "Drunkard's Walk" is a special form of the random walk problem
  - The drunk flips a coin to determine right or left with each step forward
  - The random variable is direction
- The Diffusion equation is the solution
  - describes smoke coming from a smokestack
- The smoke plume is analogous to market conditions
  - Breeze bends the plume to an average trendline
  - Plume widens with distance - distant predictions are less accurate
  - Smoke density is analogous to prediction probability - the best estimator is the average

Telegraphers' Equation

- Modify the "Drunkard's Walk" problem
  - Coin flip decides whether the drunk will reverse his direction, regardless of the direction of the last step
  - The random variable is now momentum, not direction
- Solution is now the Telegrapher's Equation
  - Describes the electric wave on a telegraph wire
  - Also describes a meandering river
- A river meander is a short term cycle
  - Random probability exists (Diffusion Equation) IF:
    - Individual meanders are overlaid
    - Or a long data span is taken

The Market is similar to a meandering river

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- Both follow the path of least resistance
- Rivers attempt to keep a constant water slope - maintains the conservation of energy.
- Conservation of Energy produces the path of least resistance
  - Paths of uniform resistance look like pieces of sinewaves
- Market Forces (greed, fear, profit, loss, etc.) are similar to physical forces, producing paths of uniform resistance.
- Think about how the masses ask the question:

  Will the market change?

  OR

  Will the trend continue?

Market Modes

- My market model only has two modes
  - Trend Mode
  - Cycle Mode
- Market Cycles can be measured
- If the cycles are removed from the data, the residual must be the Trend

Measuring Spectra is Difficult

- Must Measure a Triple infinity of Variables Simultaneously
  - Frequency
  - Amplitude
  - Phase
- Potential measurement techniques:
  - Count bars between successive highs (or lows)
  - FFT
  - MESA
  - Hilbert Transform

FFT

- Constraints:
  - Data is a representative sample of an infinitely long wave
  - Data must be stationary over the sample time span
  - Must have an integer number of cycles in the time span
- Assume a 64 day time span
  - Longest cycle period is 64 days
  - Next longest is 64 / 2 = 32 days
  - Next longest is 64 / 3 = 21.3 days
  - Next longest is 64 / 4 = 16 days
- Result is poor resolution - gaps between measured cycles

FFT (continued)

Paradox:

- The only way to increase resolution is to increase the data length
- Increased data length makes realization of the stationarity constraint highly unlikely
  - 256 data points are required to realize a 1 bar resolution for a 16 bar cycle (right where we want to work)

Conclusion:

FFT measurements are not suitable for market analysis

Still Not Convinced?

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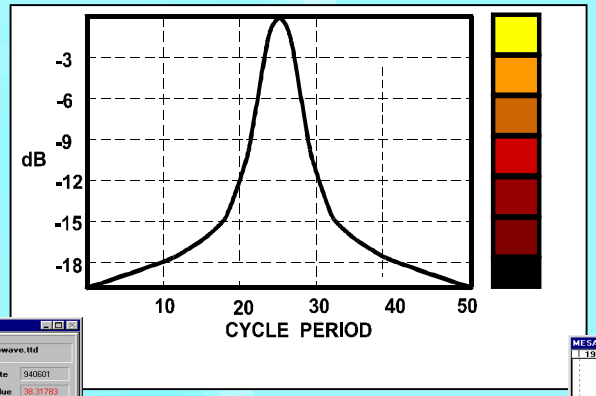
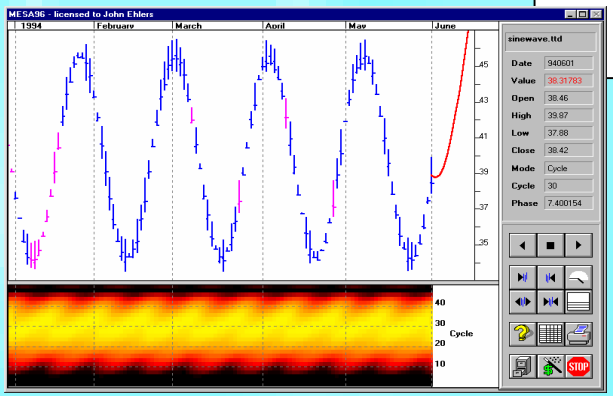


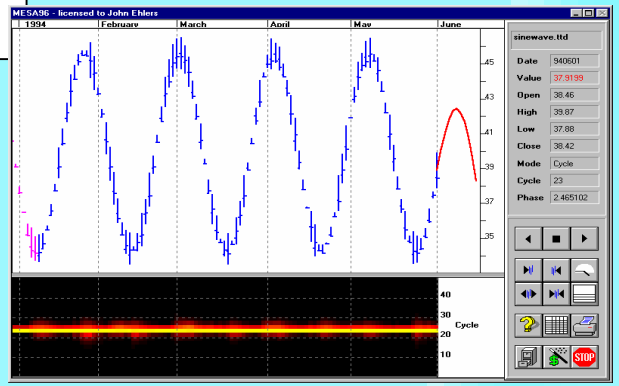
Spectrum Amplitude is converted to color

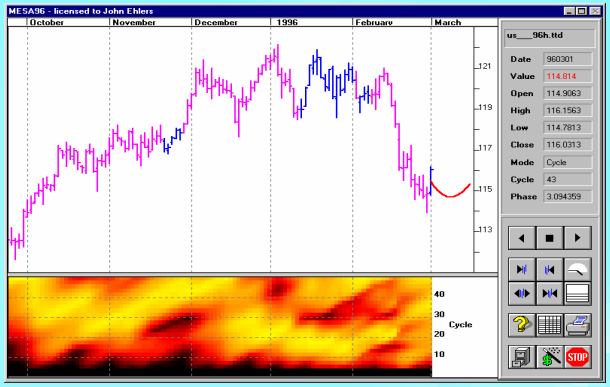
FFT

MESA

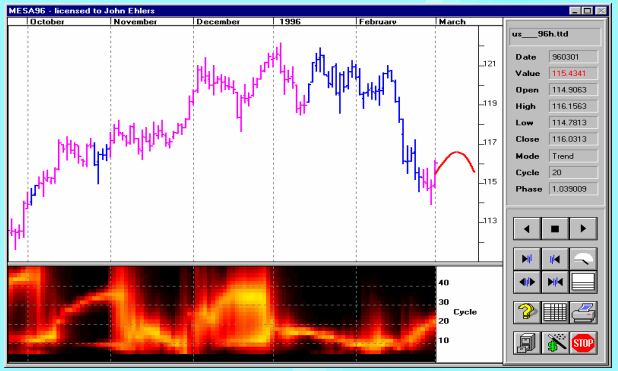


Theoretical 24 Bar Cycle





Treasury Bonds



MESA Indicates and Trades Both Market Modes

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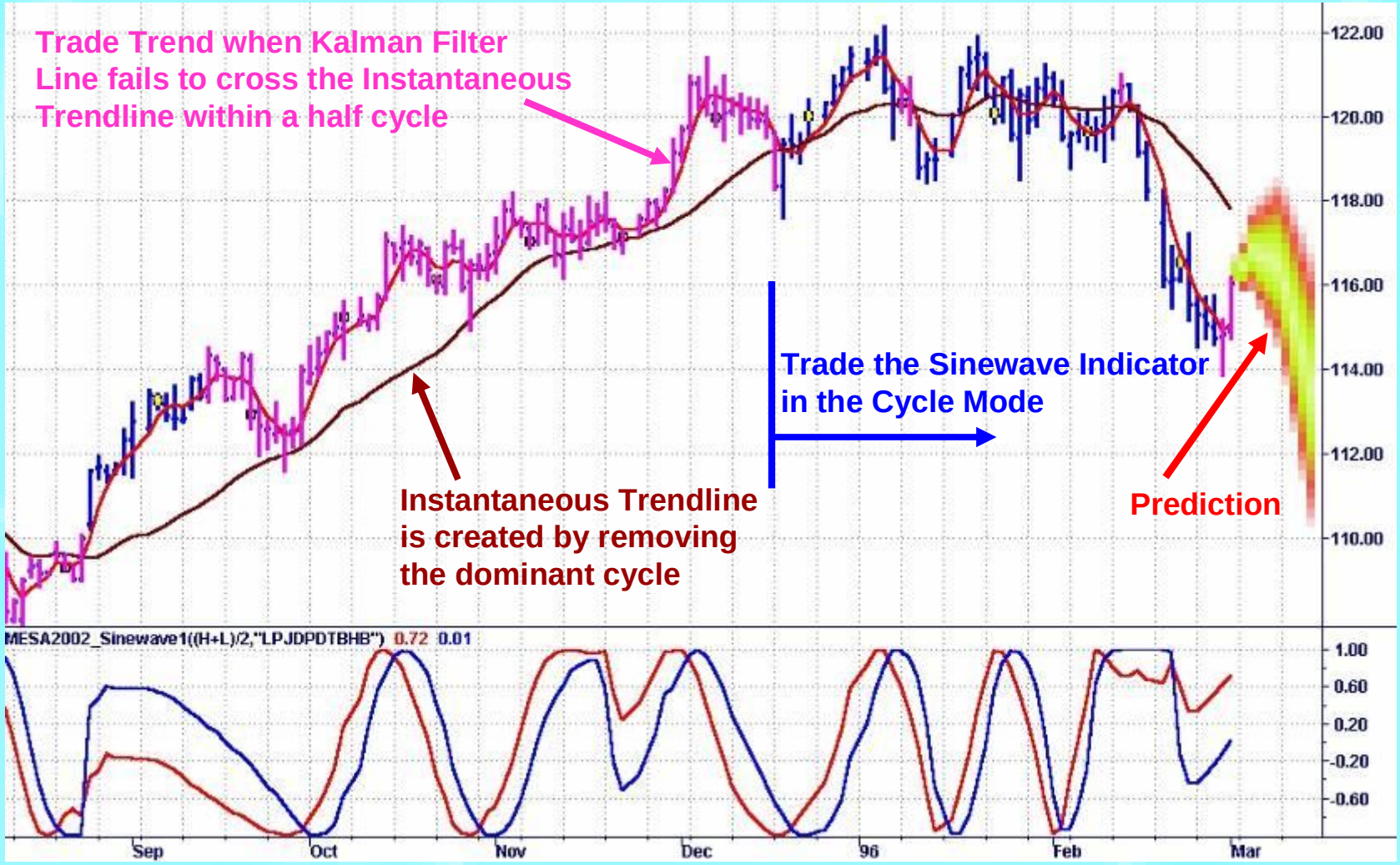

MESA Customer Feedback

John Ehlers

"The results I have achieved are very impressive. In the course of my investigations, I've discovered that most stocks can be traded in the cycle-mode *OR* trend-mode - rarely both."

Peter S. Campbell

MESA Can Improve Even the Best Indicators by Making Them Adaptive

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Basic Technical Tools

- Moving Averages
  - Smooth the data
  - Analogous to the Integral in Calculus
- Momentum Functions (Differences)
  - Sense rate of change
  - Analogous to the Derivative in Calculus
- All indicators are combinations of these tools

Moving Averages

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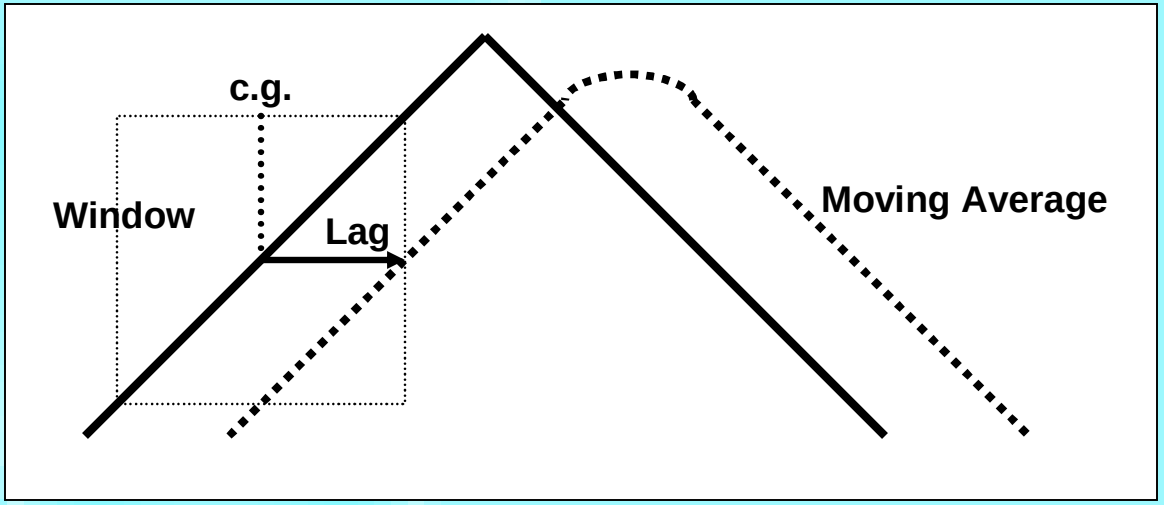

CONCLUSIONS:

1. Moving Averages smooth the function
2. Moving Averages Lag by the center of gravity of the observation window
3. Using Moving Averages is always a tradeoff between smoothing and lag

Momentum Functions

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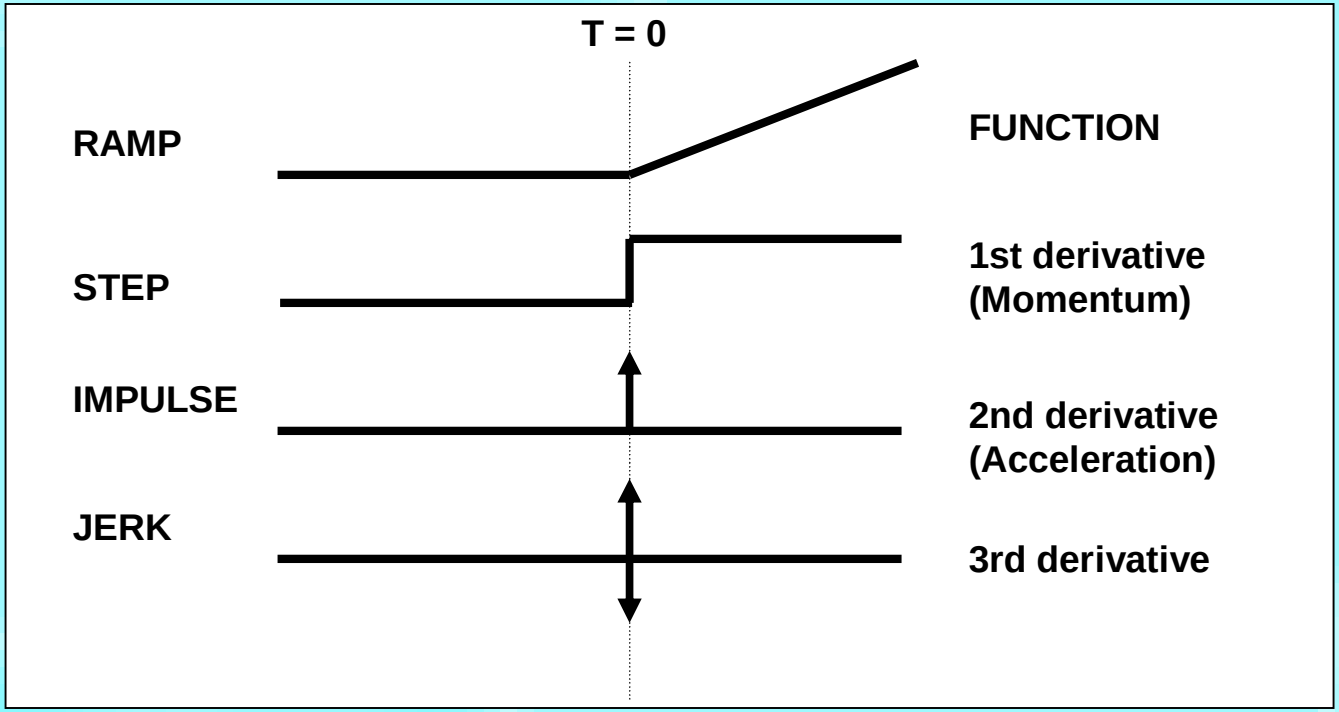


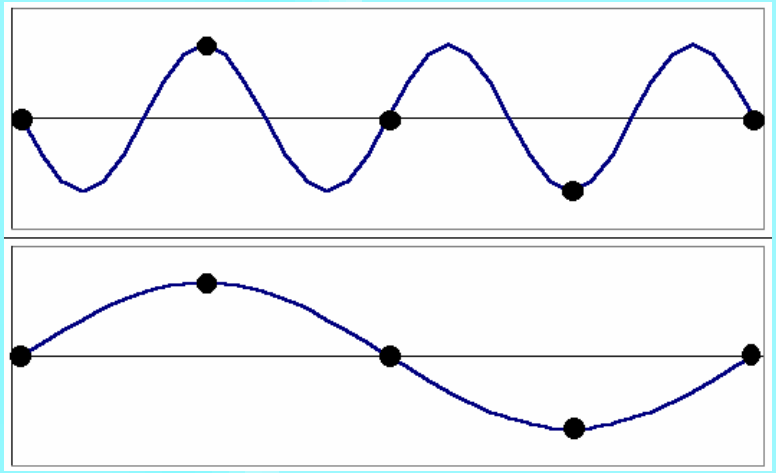
CONCLUSIONS:

1. Momentum can NEVER lead the function
2. Momentum is always more disjoint (noisy)

FIR Filters

Frequency is the Reciprocal of Cycle Period

- Must have at least 2 samples per cycle
  - Nyquist Criteria



- Shortest period allowed is a 2 bar cycle
  - This is the Nyquist Frequency
- Normalized frequency is 2 / Period

FIR Filters

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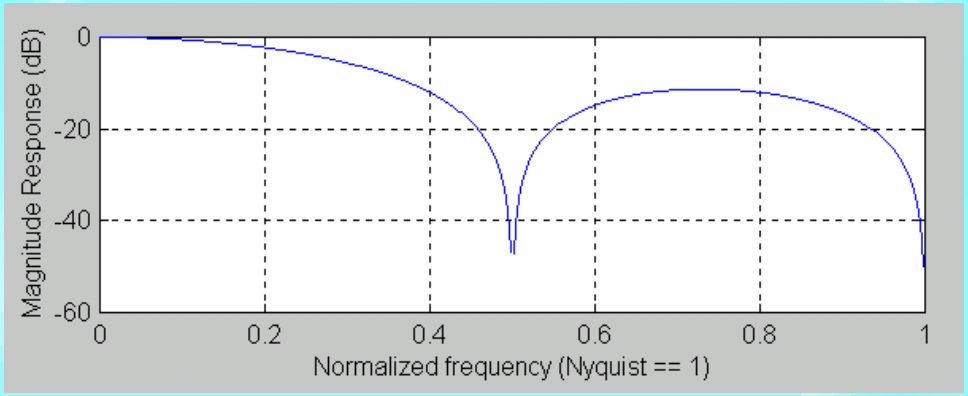
Symmetrical FIR Filter Lag is (N - 1) / 2 for all frequencies

Simple 4 bar moving average
where a = [1 1 1 1] / 4

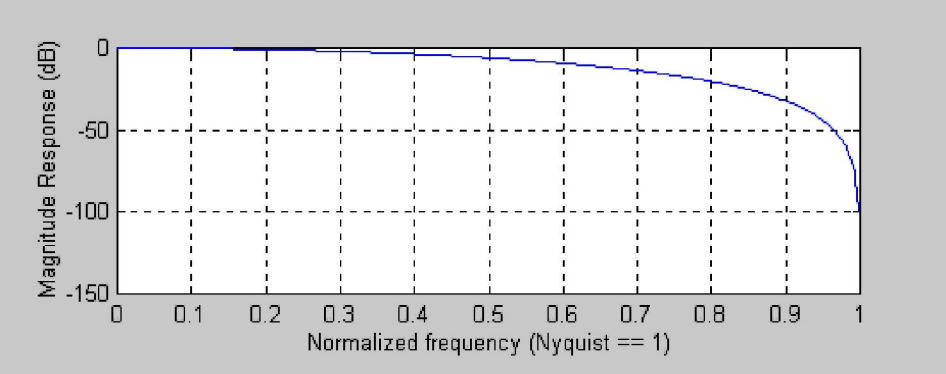
Delay is 1.5 bars
Notches out 2 & 4 bar cycles



Tapering the coefficients reduces the sidelobe amplitude

For a 3 tap filter
where a = [1 2 1] / 4

Delay is 1 bar
Notches out only a 2 bar cycle



Special FIR Filters of Interest to Traders

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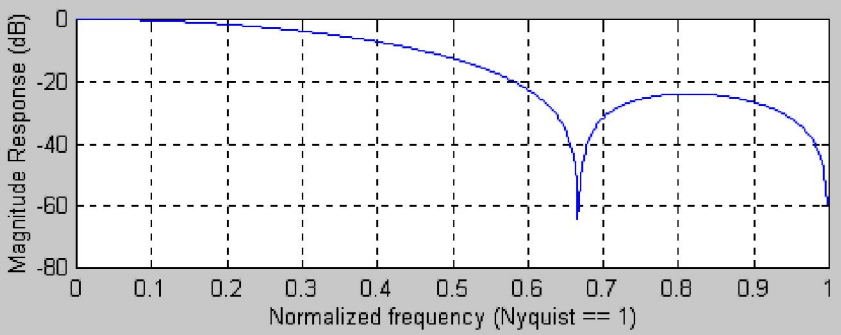
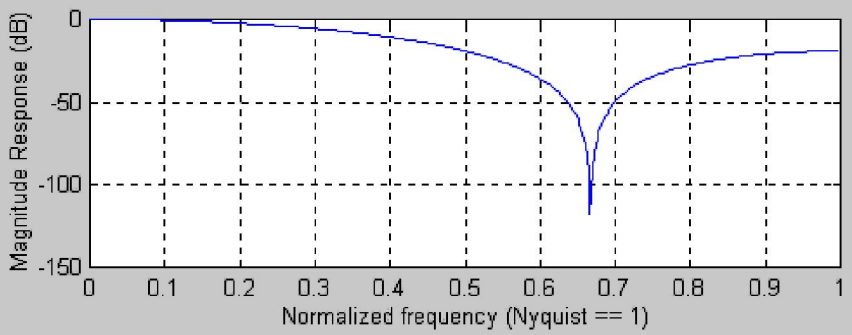


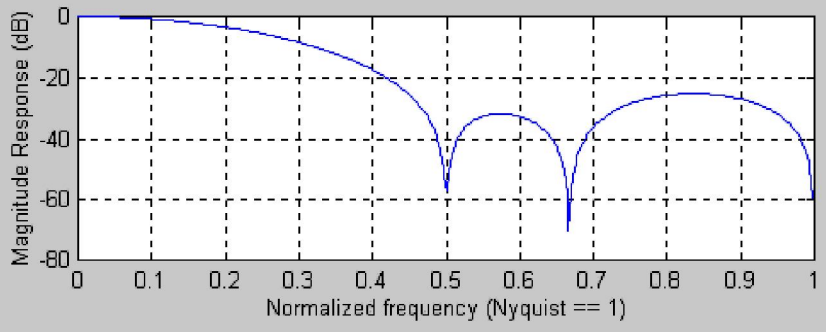
Four tap filter
a = [1 2 2 1] /6

lag is 1.5 bars
notches 2 & 3 bar cycles

Five tap filter
a = [1 2 3 2 1] /9

lag is 2 bars
notches only 3 bar cycle





Six tap filter
a = [1 2 3 3 2 1] /12

lag is 2.5 bars
notches 2, 3, & 4 bar cycles

Isolating the Cycle Component

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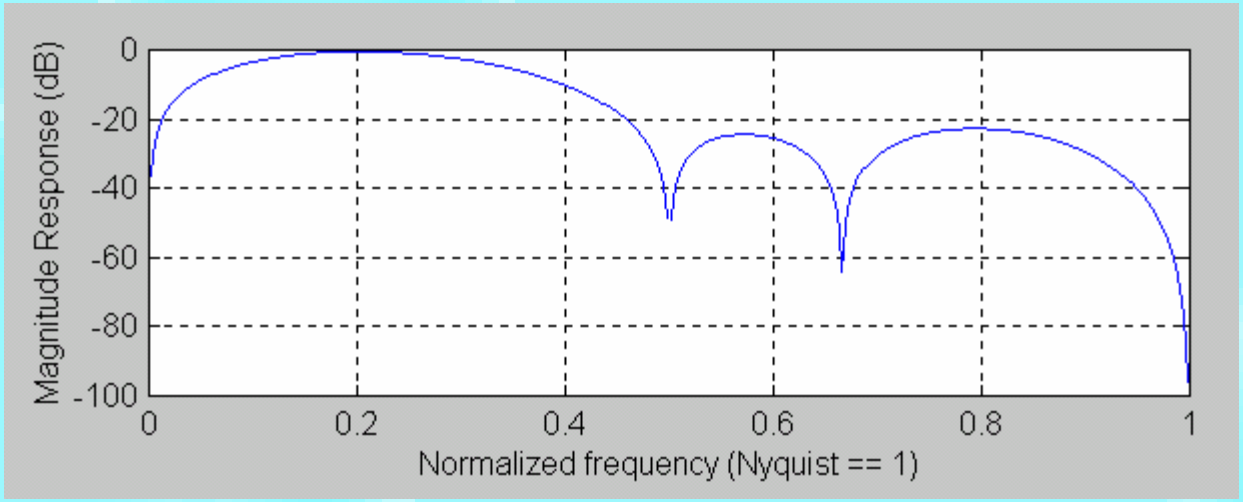
Create a Bandpass filter

- Low Pass for Smoothing
- High Pass to remove the Trend

Method: Take a two bar momentum of a 6 bar Tapered FIR Filter

[1 2 3 3 2 1] / 12
-[1 2 3 3 2 1] / 12

[1 2 2 1 -1 -2 -2 -1] / 12



How the Cycle Component Looks

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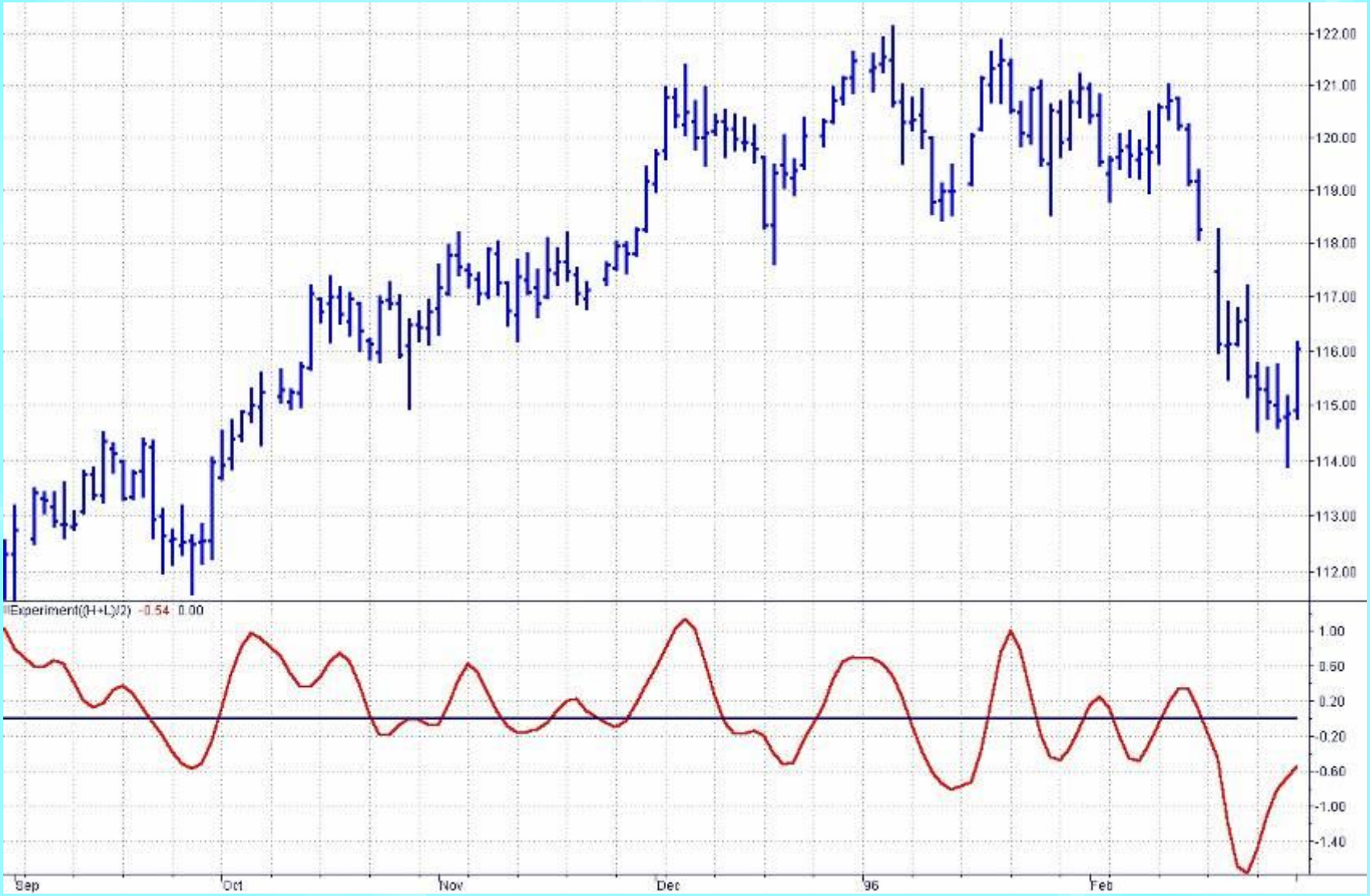

Capture the Cycle Turning Points with the Cycle Delayed One Bar

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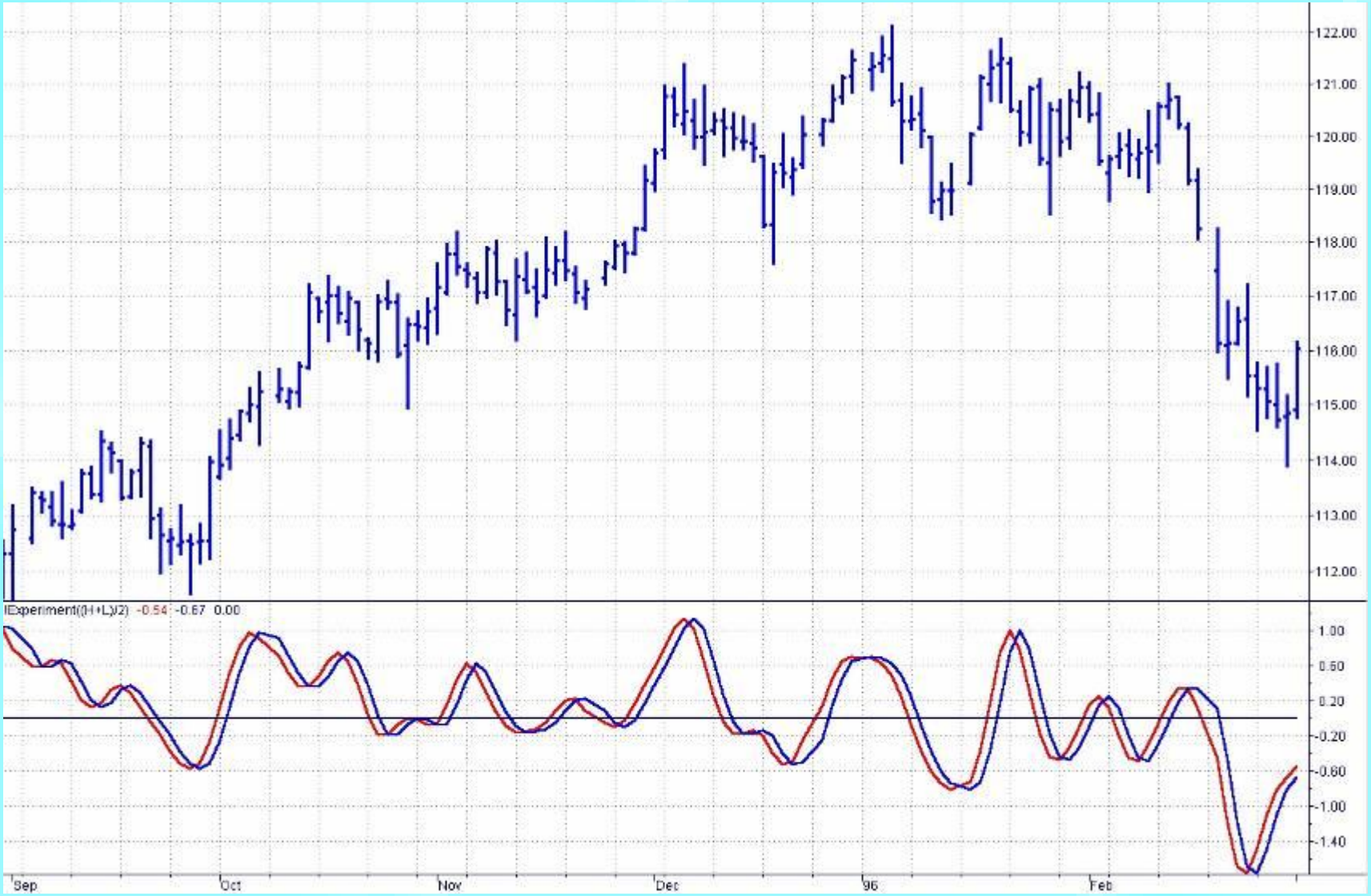

Cycle Does Not Require Adjustable Parameters

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Fisher Transformation

Many Indicators Assume a Normal Probability Distribution

- Example - CCI
  - by Donald Lambert in Oct 1980 Futures Magazine
- CCI = (Peak Deviation) / (.015* Mean Deviation)
- Why .015?
  - Because 1 / .015 = 66.7
  - 66.7 is (approximately) one standard deviation
    - **IF THE PROBABILITY DENSITY FUNCTION IS NORMAL**

What are Probability Density Functions?

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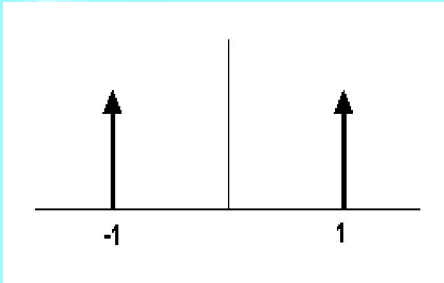
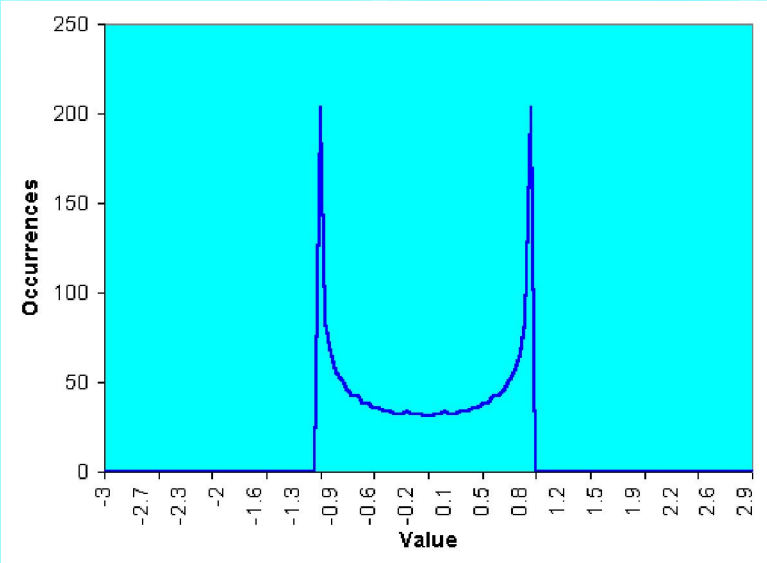


A Square Wave only has two values

A Square Wave is untradeable with conventional Indicators because the switch to the other value has occurred before action can be taken

A PDF can be created by making the waveform with beads on parallel horizontal wires. Then, turn the frame sideways to see how the beads stack up.



A Sinewave PDF is not much different from a Squarewave PDF

Probably one reason why trading cycles has such a bad reputation.

The Fisher Transform Generates Waves Having Nearly a Normal PDF

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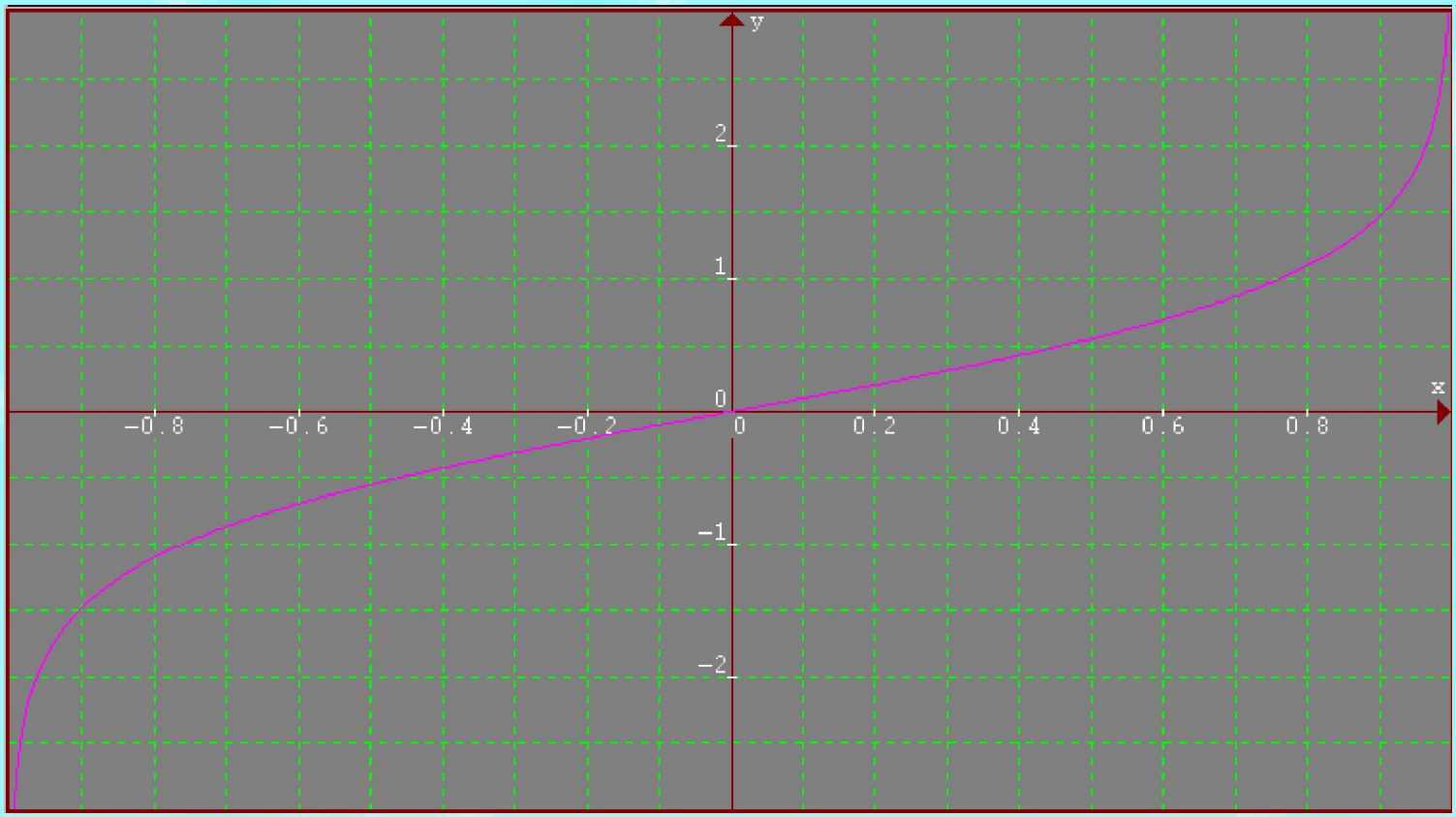
- Y = .5*ln((1 + X) / (1 - X))

  where -1 <= X <= 1



Fisher Transform Converts a Sinewave PDF to a Normal PDF

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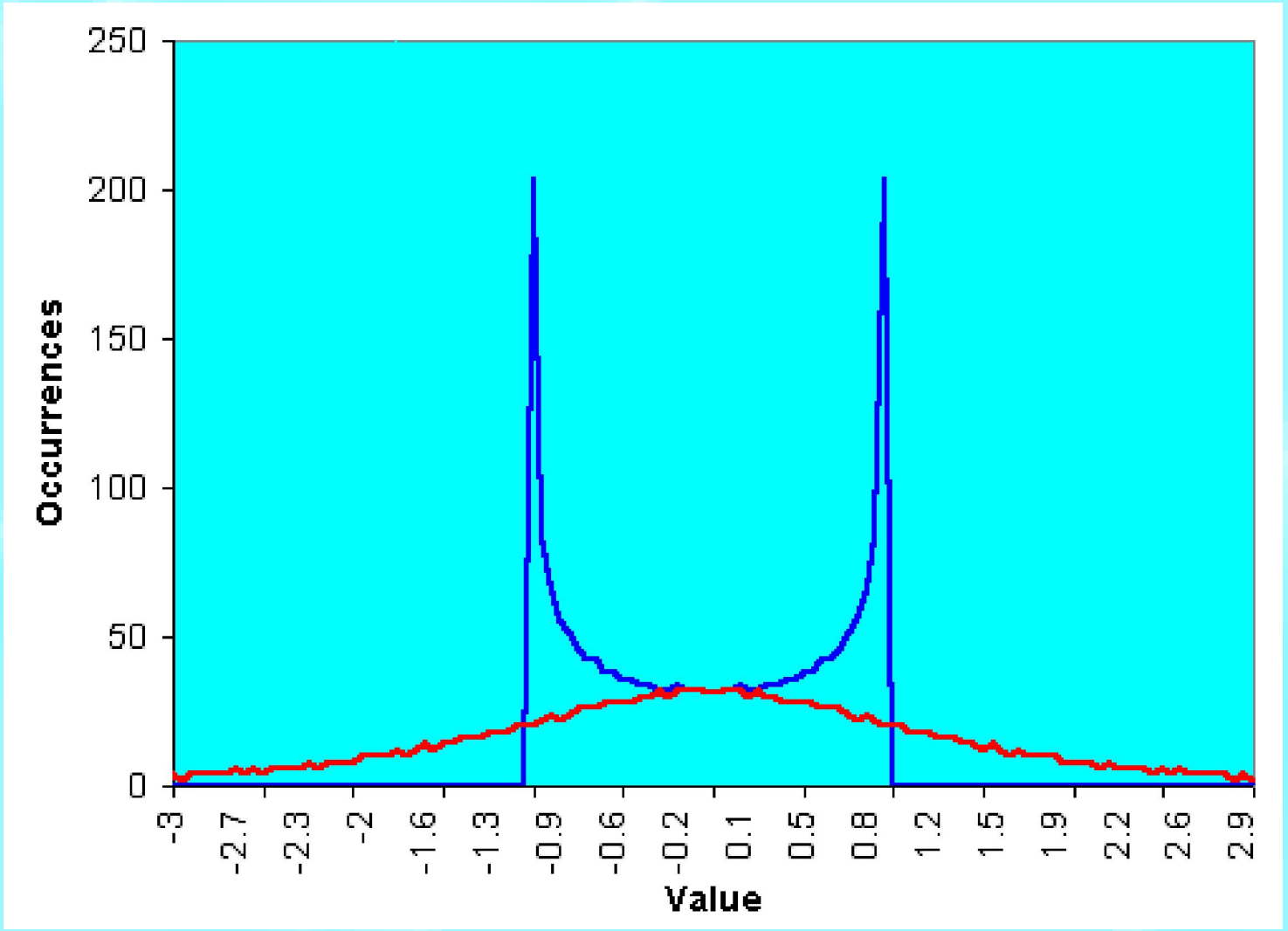

Real World Fisher Transform PDFs

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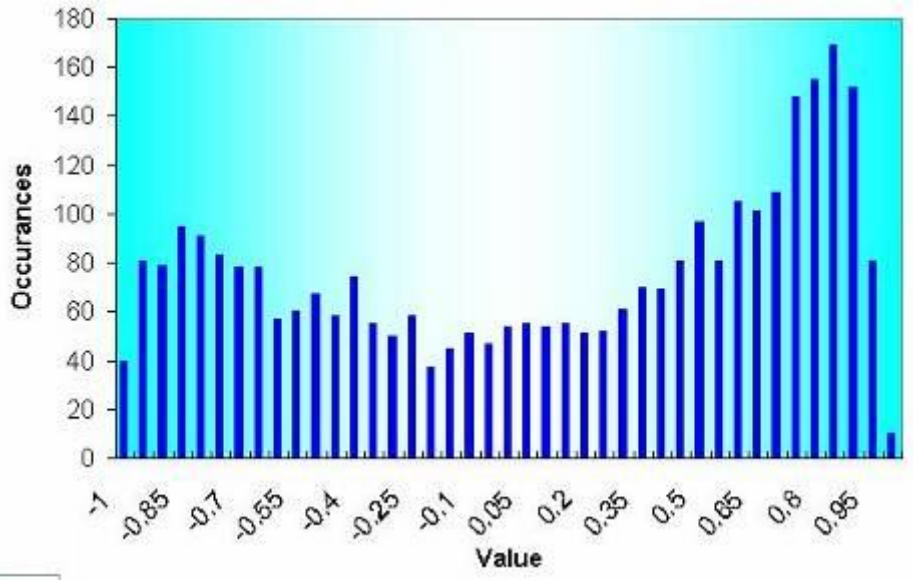
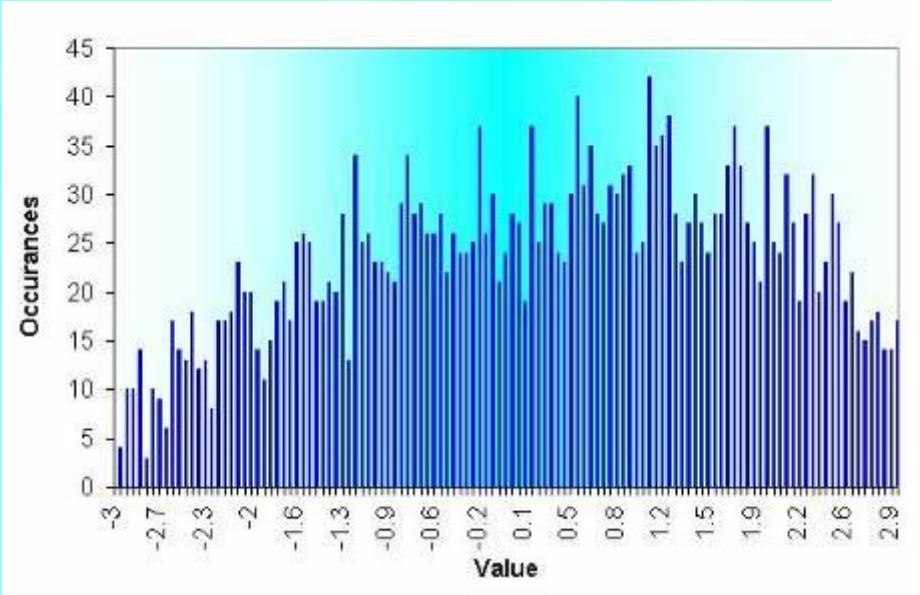
12 Year PDF of
Treasury Bond Futures





Fisher Transform PDF of
12 Year Treasury Bond Data

Fisher Transform Code is Simple

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- Compute Normalized Price Channel
- Apply Transform

```
Inputs:     Price((H+L)/2),
            Len(5);

Vars:       MaxH(0),
            MinL(0),
            Fish(0);

MaxH = Highest(Price, Len);
MinL = Lowest(Price, Len);

Value1 = .33*2*((Price - MinL)/(MaxH - MinL) - .5) + .67*Value1[1];
If Value1 > .999 then Value1 = .999;
If Value1 < -.999 then Value1 = -.999;

Fish = .5*Log((1 + Value1)/(1 - Value1)) + .5*Fish[1];

Plot1(Fish, "Fisher");
Plot2(Fish[1], "Trigger");
```

Fisher Transform Turning Points are Sharper and Have Less Lag

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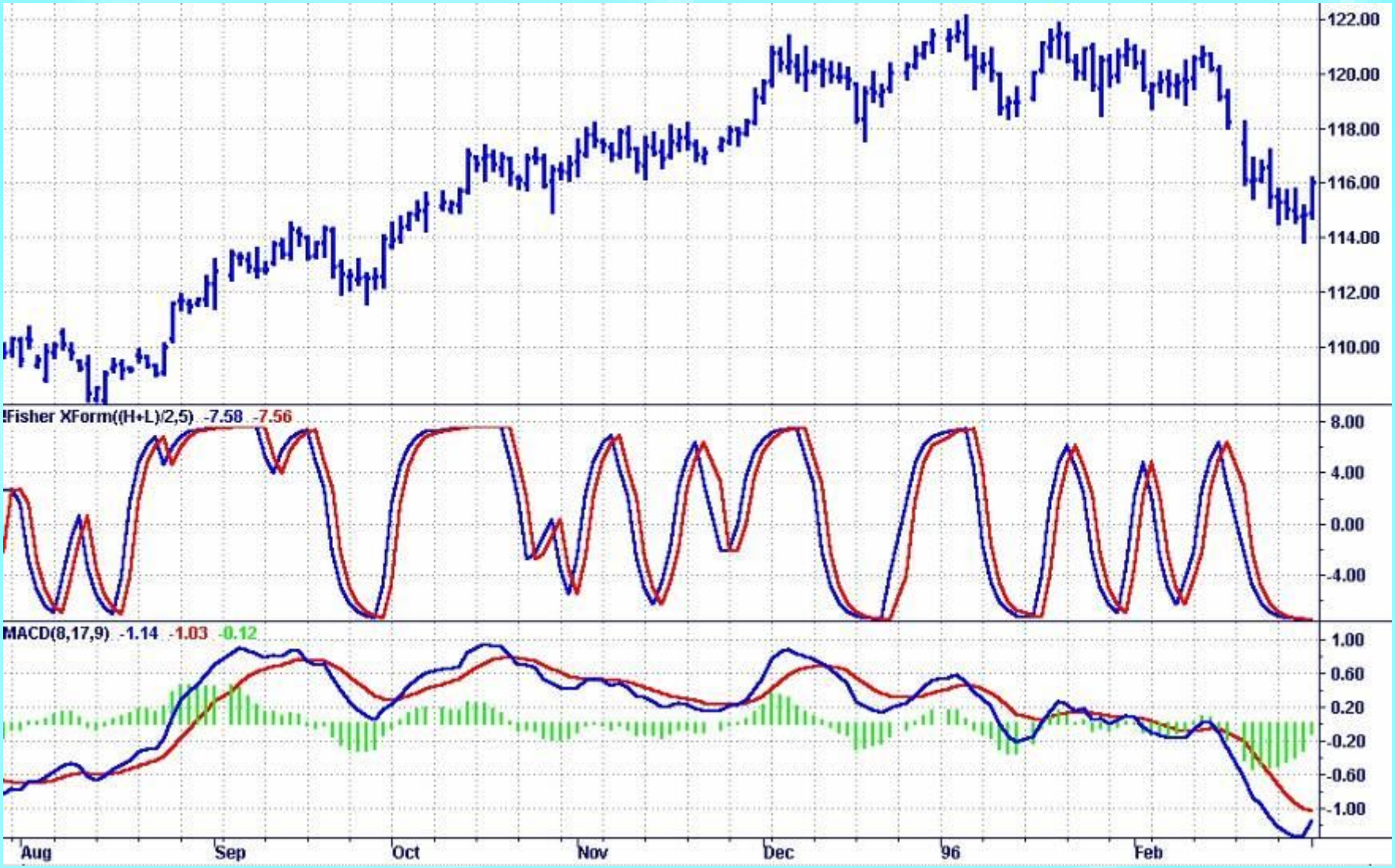

Fisher Transform Channel Has Fewer Whipsaws Than StochasticRSI

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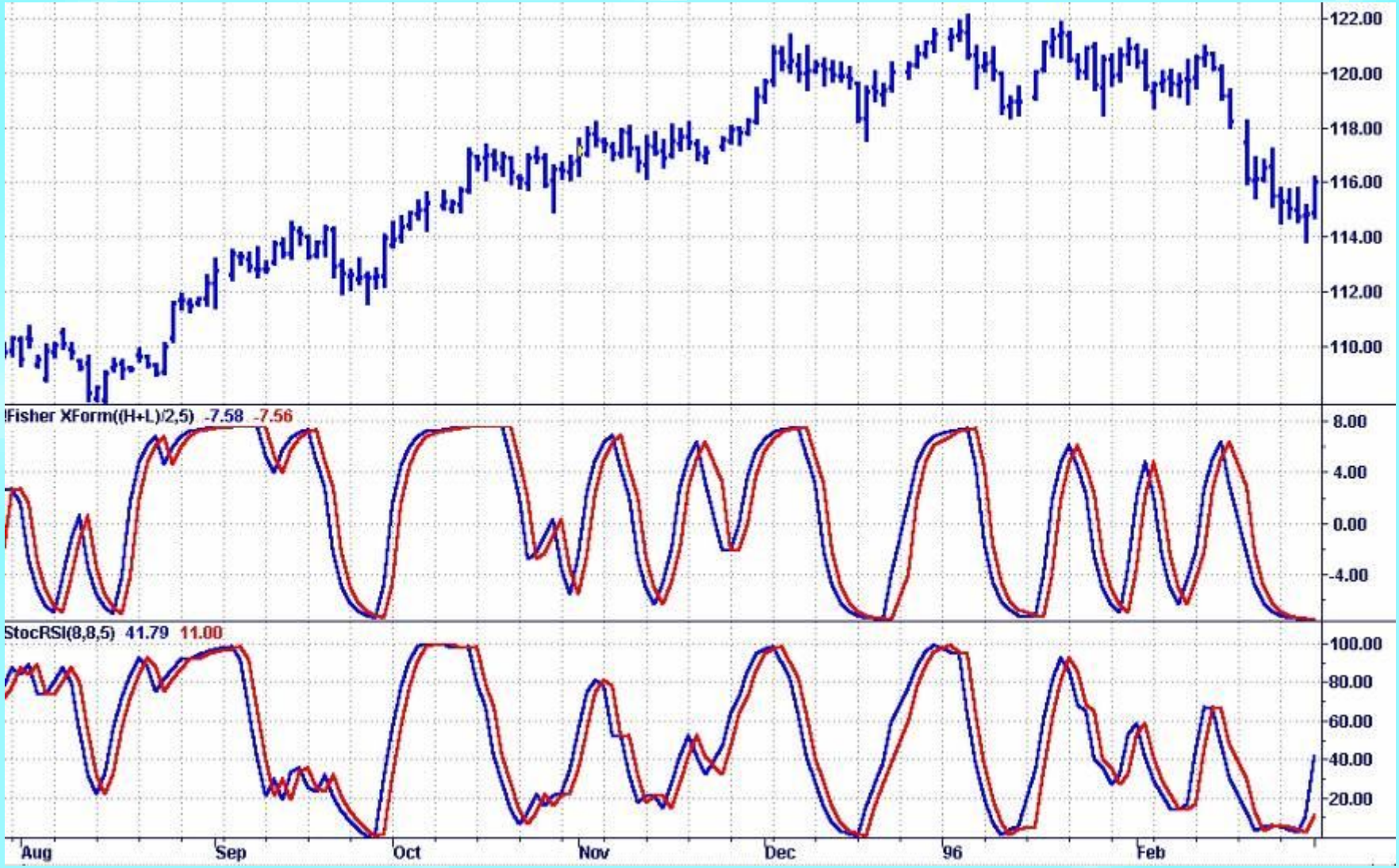

Fisher Transform Can Sharpen the Real StochasticRSI Turning Points

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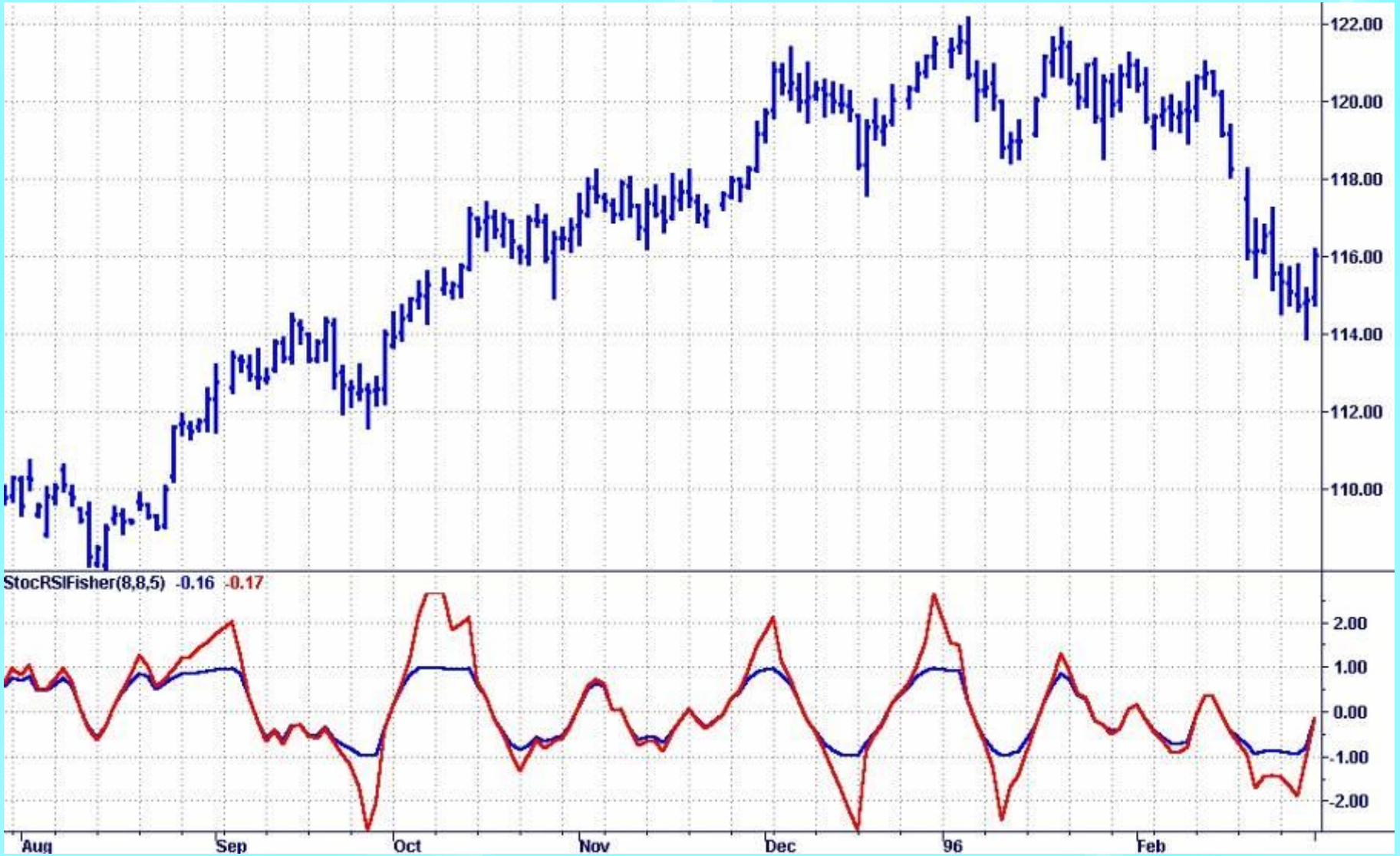

Conclusions

- The Drunkard's Walk is the underpinning for identifying inefficiencies in the Trend Mode and Cycle Mode
- You have seen how MESA trades both Modes
- Your indicators and systems can be improved by making them adaptive to the measured cycles
- You have Simple FIR Filters for data smoothing in your Toolbox
  - You have a simple way to see the Cycle Component
- You can more accurately identify turning points by modifying the PDF using the Fisher Transform