Building Trading Systems
On NonLinear Filters

Presented by John Ehlers
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System Design Approach

• Pick nonlinear moving averages as the base technology to react to major moves and avoid whipsaws in sideways markets

• Survey available nonlinear moving averages
• Select a time-based event
• Include volatility guards
• Add loss escape mechanism
Nonlinear Moving Average Survey

• Eight Approaches are considered
  – KAMA (Kaufman Adaptive Moving Average)
  – VIDYA (Variable Index Dynamic Average)
  – MAMA (MESA Adaptive Moving Average)
  – Ehlers Filter
  – Median Filter
  – Median-MA Difference Filter
  – FRAMA (Fractal Adaptive Moving Average)
  – Nonlinear Laguerre Filter
KAMA (Kaufman Adaptive Moving Average)


• Adjusts the alpha of an EMA according to volatility
  – Ratios the price difference over a time span to the sum of the bar-to-bar price differences over the time span

• Alpha is limited to range between a lower and upper bound
KAMA Indicator EL Code

Inputs:  Price((H+L)/2), Len(10), FastLen(2), SlowLen(30);

Vars:  count(0), Num(0), Denom(0), ER(0), Fastest(0), Slowest(0),
       alpha(0), Filt(0);

Num = AbsValue(Price - Price[Len]);
Denom = 0;
For count = 0 to Len begin
    Denom = Denom + AbsValue(Price[count] - Price[count + 1]);
End;
If Denom <> 0 then ER = Num / Denom;
Fastest = 2 / (FastLen + 1);
Slowest = 2 / (SlowLen + 1);
alpha = Square(ER*(Fastest - Slowest) + Slowest);
Filt = alpha*Price + (1 - alpha)*Filt[1];
If CurrentBar = 1 then Filt = Price;

Plot1(Filt, "KAMA");
VIDYA (Variable Index Dynamic Average)

• Developed by Tushar Chande and Stanley Kroll in “The new Technical Trader”, John Wiley & Sons, 1984

• Dynamically adjusts the alpha of an EMA according to the ratio of the Standard Deviation of prices over a period to the Standard Deviation of prices over a longer period
  – Modifies the alpha of a suggested 9 bar EMA
    • alpha = 2 / (length + 1)
VIDYA Indicator EL Code

Inputs: M(30), N(9);

Vars: k(0), VIDYA(0);

If StdDev(Close, M) <> 0 then k = StdDev(Close, N) / StdDev(Close, M);

Filt = .2*k*Close + (1 - .2*k)*Filt[1];
If CurrentBar = 1 then Filt = Close;

Plot1(Filt, "VIDYA");
MAMA (MESA Adaptive Moving Average)

- Uses the Hilbert Transform to measure the current dominant cycle period
- Computes the phase of the dominant cycle
- Computes the alpha inversely proportional to the rate change of phase
  - Shorter periods have higher rate changes of phase
    - Large alpha - more responsive EMA
  - Longer periods have lower rate changes of phase
    - Smaller alpha - gives EMA more smoothing
- High rate change of phase due to snap-back every 180 degrees ensures EMA will tightly follow price
MAMA Indicator EL Code

Inputs: Price((H+L)/2), speed(.8), FastLimit(.5), SlowLimit(.05);
Vars: Smooth(0), Detrender(0), I1(0), Q1(0), jI(0), jQ(0), I2(0), Q2(0), Re(0), Im(0), Period(0), SmoothPeriod(0), Phase(0),
DeltaPhase(0), alpha(0), Filt(0);
If CurrentBar > 5 then begin
(Compute InPhase and Quadrature components)
I1 = Detrender[3];
(Advance the phase of I1 and Q1 by 90 degrees)
(Phasor addition for 3 bar averaging)
I2 = I1 - jQ;
Q2 = Q1 + jI;
(Smooth the I and Q components before applying the discriminator)
I2 = .2*I2 + .8*I2[1];
Q2 = .2*Q2 + .8*Q2[1];
(Homodyne Discriminator)
Re = I2*I2[1] + Q2*Q2[1];
Im = I2*Q2[1] - Q2*I2[1];
Re = .2*Re + .8*Re[1];
Im = .2*Im + .8*Im[1];
If Im <= 0 and Re <= 0 then Period = 360/ArcTangent(Im/Re);
If Period > 1.5*Period[1] then Period = 1.5*Period[1];
If Period < .67*Period[1] then Period = .67*Period[1];
If Period < 6 then Period = 6;
If Period > 50 then Period = 50;
Period = .2*Period + .8*Period[1];
SmoothPeriod = .33*Period + .67*SmoothPeriod[1];
If I1 <= 0 then Phase = (ArcTangent(Q1 / I1));
DeltaPhase = Phase[1] - Phase;
If DeltaPhase < 1 then DeltaPhase = 1;
alpha = Speed / DeltaPhase;
If alpha < SlowLimit then alpha = SlowLimit;
If alpha > FastLimit then alpha = FastLimit;
Filt = alpha*Price + (1 - alpha)*Filt[1];
End;
If CurrentBar <= 5 then Filt= Price;
Plot1(Filt, "MAMA");
Ehlers Filter

- Unlike most nonlinear filters, it is a FIR filter
- Analogous to determining sharpness of a piece of paper creased and draped over the edge of a table

- FIR coefficients are computed as “distance” vectors - squared price differences are summed
- Coefficients are normalized to their sum for unity gain
Ehlers Filter EL Code

Inputs:  Price((H+L)/2), Length(20);

Vars:  Smooth(0), count(0), LookBack(0), SumCoef(0), Num(0), Filt(0);

Array:  Coef[50](0), Distance2[50](0);


For count = 0 to Length -1 begin
  Distance2[count] = 0;
  For Lookback = 1 to Length-1 begin
    Distance2[count] = Distance2[count] + (Smooth[count] - Smooth[count + Lookback])*(Smooth[count] - Smooth[count + Lookback]);
  End;
  Coef[count] = Distance2[count];
End;

Num = 0;
SumCoef = 0;
For count = 0 to Length -1 begin
  Num = Num + Coef[count]*Smooth[count];
  SumCoef = SumCoef + Coef[count];
End;
If SumCoef <> 0 then Filt = Num / SumCoef;

Plot1(Filt, "Ehlers");
Median Filter

- Rank-order filter
- Easy to compute
- Often used to sharpen video images
- Useful to smooth impulsive type noise by ignoring outliers
Median Filter EL Code

Inputs: Price((H+L)/2), Len(4);

Vars: Filt(0);

Filt = Median(Price, 2*Len + 1);

Plot1(Filt, "Median");
Median-MA Difference Filter

• Adjusts the alpha of an EMA according to the differential responses of Median and MA filters
• Consider a price string of ten 1s
  – Both the Median and MA is 1
• New price data point has a value of 10
  – Median output is still 1 (new price value is ignored)
  – Simple MA value is 1.9
• Searches for a filter length where the output differences fall below a selected threshold
  – Fast moving markets produce the shortest (most responsive) filter
Median-MA Difference Filter EL Code

Inputs: Price((H+L)/2), Threshold(.0025);

Vars: Smooth(0), Length(30), alpha(0), Filt(0);

Length = 39;
Value3 = 1;
While Value3 > Threshold begin
    alpha = 2 / (Length + 1);
    Value1 = Median(Smooth, Length);
    Value2 = alpha*Smooth + (1 - alpha)*Value2[1];
    If Value1 <> 0 then Value3 = AbsValue(Value1 - Value2) / Value1;
    Length = Length - 2;
End;
If Length < 3 then Length = 3;
alpha = 2 / (Length + 1);
Filt = alpha*Smooth + (1 - alpha)*Filt[1];
If CurrentBar < 4 then Filt = Price;
Plot1(Filt, "Med-MA");
FRAMA (Fractal Adaptive Moving Average)

• There is no argument that the market moves as a fractal
• A period is selected to compute the fractal dimension
  – The price difference over the first half of the range, second half of the range, and over the total range is used for the computation
• Since the market prices move as log-normal, the fractal dimension is used to compute filter alpha as
  \[ \alpha = \exp(-4.6 \times (Dimen - 1)) \]
  – When Dimen = 1, \( \alpha = 1 \) - a very fast filter
  – When Dimen = 2, \( \alpha = .01 \) - about a 200 bar filter
FRAMA Filter EL Code

Inputs: 
Price((H+L)/2), N(20);

Vars: 
count(0), N1(0), N2(0), N3(0), HH(0), LL(0), Dimen(0), alpha(0), Filt(0);

N3 = (Highest(High, N) - Lowest(Low, N)) / N;
HH = High;
LL = Low;
For count = 0 to N/2 - 1 begin
  If High[count] > HH then HH = High[count];
  If Low[count] < LL then LL = Low[count];
End;
N1 = (HH - LL)/(N/2);
HH = High[N/2];
LL = Low[N/2];
For count = N/2 to N - 1 begin
  If High[count] > HH then HH = High[count];
  If Low[count] < LL then LL = Low[count];
End;
N2 = (HH - LL)/(N/2);

If N1 > 0 and N2 > 0 and N3 > 0 then Dimen = (Log(N1 + N2) - Log(N3)) / Log(2);

{alpha = .02 when Dimen = .7 and alpha = .33 when Dimen = .05}
alpha = ExpValue(-4.6*(Dimen - 1));
If alpha < .01 then alpha = .01;
If alpha > 1 then alpha = 1;

Filt = alpha*Price + (1 - alpha)*Filt[1];
If CurrentBar < N + 1 then Filt = Price;

Plot1(Filt, "FRAMA");
A Laguerre filter warps time in the filter coefficients
  - Enables extreme smoothing with just a few filter terms

A NonLinear Laguerre filter measures the difference between the current price and the last computed filter output.
  - Objective is to drive this “error” to zero
  - The “error”, normalized to the error range over a selected period is the alpha of the Laguerre filter
Nonlinear Laguerre Filter EL Code

Inputs:  Price((H+L)/2), Length(20);
Vars:    Diff(0), HH(0), LL(0), count(0), alpha(0), L0(0), L1(0), L2(0), L3(0), Filt(0), FIR(0);

Diff = AbsValue(Price - Filt[1]);
HH = Diff;
LL = Diff;
For count = 0 to Length - 1 begin
  If Diff[count] > HH then HH = Diff[count];
  If Diff[count] < LL then LL = Diff[count];
End;
If CurrentBar > Length and HH - LL <> 0 then alpha = Median(((Diff - LL) / (HH - LL)), 5);
L0 = alpha*Price + (1 - alpha)*L0[1];
L1 = -(1 - alpha)*L0 + L0[1] + (1 - alpha)*L1[1];
L2 = -(1 - alpha)*L1 + L1[1] + (1 - alpha)*L2[1];
L3 = -(1 - alpha)*L2 + L2[1] + (1 - alpha)*L3[1];
Filt = (L0 + 2*L1 + 2*L2 + L3) / 6;
If CurrentBar < Length then begin
  L0 = Price;
  L1 = Price;
  L2 = Price;
  L3 = Price;
  Filt = Price;
End;
Plot1(Filt, "Laguerre");
NonLinear Filter Comparison (1)

MAMA

KAMA

EHLERS

VIDYA
NonLinear Filter Comparison (2)

- Laguerre
- Median
- FRAMA
- Med-MA
Filter Selection Process

- Rank each filter according to smoothness on a scale from 1 to 8
- Rank each filter according to responsiveness on a scale from 1 to 8
- Add the rankings to obtain a score
  - low score is the best filter for the job

<table>
<thead>
<tr>
<th>Filter</th>
<th>Smoothness</th>
<th>Responsive</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAMA</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>VIDYA</td>
<td>6</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>MAMA</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Ehlers</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Median</td>
<td>8</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Median-MA</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>FRAMA</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Laguerre</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>
Time Based Event

- Line crossings are distinctive events easily identified in automatic systems.
- Create a trigger by delaying the nonlinear filter by one bar.

- The problem is that crossings create whipsaws in sideways markets - need hysteresis.
Volatility-Based Histeresis Channel

- Measure the average range (can use Average True Range if desired)
- Add and subtract a fraction of the average range to the NonLinear Filter
Trading Strategy Code

- Any NonLinear Filter can be used
- To NonLinear Filter code add:
  - Also declare Rng variable and add Frac Input
    
    ```
    Rng = .1*(High - Low) + .9*Rng[1];
    Value1 = Filt[1] + Rng / Frac;
    Value2 = Filt[1] - Rng / Frac;
    ```

  - If Filt Crosses Over Value1 Then Buy Next Bar on Open;
  - If Filt Crosses Under Value2 Then Sell Short Next Bar on Open;

- Trading Rules are simple
  - Contains time event trigger as Filt[1]
  - Contains Hysteresis channel as ± Rng/Frac

- Trading system is always in the market - reversing between long and short positions
  - Excellent approach for Commodities and ETFs
  - Long-Only positions for stocks can be taken
Efficiency Tips

• Precede indicator or strategy name with a special character like “!” or “*” or “=“
  – This moves your custom indicators and strategies to the top of the TradeStation list

• Precede research indicators and strategies with double special characters like “!!” or “**” or “==“
  – Avoids versionitis - you know you can delete one of these later without worrying about losing content
  – Easy converts to a custom indicator or strategy simply by removing one of the special characters
Optimization Tips

• Optimize one parameter at a time for efficiency
  – Iterate if necessary
• A good optimization will have a gentle “mound”
• Parameters should be robust over a wide range

Frac Optimization on EC

Length Optimization on EC
Maximum Adverse Excursion

• Large losers indicate a loss escape is desirable

• Add the following code to the system to reverse from a losing position

   If MarketPosition = 1 then Sell Short at EntryPrice - PtStop Stop;
   If MarketPosition = -1 then Buy at EntryPrice + PtStop Stop;
Complete System EL Code

Inputs: Price((H+L)/2), Length(20), Frac(5), PtStop(3);

Vars: Smooth(0), count(0), LookBack(0), SumCoef(0), Num(0), Filt(0), Rng(0);

Array: Coef[50](0), Distance2[50](0);


For count = 0 to Length -1 begin
    Distance2[count] = 0;
    For Lookback = 1 to Length -1 begin
        Distance2[count] = Distance2[count] + (Smooth[count] - Smooth[count + Lookback])*(Smooth[count] - Smooth[count + Lookback]);
    End;
    Coef[count] = Distance2[count];
End;

Num = 0;
SumCoef = 0;
For count = 0 to Length -1 begin
    Num = Num + Coef[count]*Smooth[count];
    SumCoef = Sumcoef + Coef[count];
End;

If SumCoef <> 0 then Filt = Num / SumCoef;

Rng = .1*(High - Low) + .9*Rng[1];

Value1 = Filt[1] + Rng / Frac;

Value2 = Filt[1] - Rng / Frac;

If Filt Crosses Over Value1 Then Buy Next Bar on Open;
If Filt Crosses Under Value2 Then Sell Short Next Bar on Open;
If MarketPosition = 1 then Sell Short at EntryPrice - PtStop Stop;
If MarketPosition = -1 then Buy at EntryPrice + PtStop Stop;
System Development Tip

- Plot Open and Closed Equity to identify problematic trades

```
INDICATOR
Plot1(I_ClosedEquity, "Closed");
Plot2(I_OpenEquity, "Open");
```
24 Year JY Equity Growth
Six Year EC Equity Growth
**Performance Summary: All Trades**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Net Profit</td>
<td>$163,887.50</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>$354,862.50</td>
</tr>
<tr>
<td>Total # of trades</td>
<td>222</td>
</tr>
<tr>
<td>Number winning trades</td>
<td>112</td>
</tr>
<tr>
<td>Largest winning trade</td>
<td>$17,962.50</td>
</tr>
<tr>
<td>Average winning trade</td>
<td>$3,168.42</td>
</tr>
<tr>
<td>Ratio avg win/avg loss</td>
<td>1.82</td>
</tr>
<tr>
<td>Max consec. Winners</td>
<td>5</td>
</tr>
<tr>
<td>Avg # bars in winners</td>
<td>48</td>
</tr>
<tr>
<td>Max intraday drawdown</td>
<td>($15,150.00)</td>
</tr>
<tr>
<td>Profit Factor</td>
<td>1.86</td>
</tr>
<tr>
<td>Account size required</td>
<td>$15,150.00</td>
</tr>
<tr>
<td>Open position P/L</td>
<td>$200.00</td>
</tr>
<tr>
<td>Gross Loss</td>
<td>($190,975.00)</td>
</tr>
<tr>
<td>Percent profitable</td>
<td>50.45%</td>
</tr>
<tr>
<td>Number losing trades</td>
<td>110</td>
</tr>
<tr>
<td>Largest losing trade</td>
<td>($5,962.50)</td>
</tr>
<tr>
<td>Average losing trade</td>
<td>($1,736.14)</td>
</tr>
<tr>
<td>Avg trade (win &amp; loss)</td>
<td>$738.23</td>
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<tr>
<td>Max consec. losers</td>
<td>5</td>
</tr>
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<td>Avg # bars in losers</td>
<td>17</td>
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<tr>
<td>Max # contracts held</td>
<td>1</td>
</tr>
<tr>
<td>Return on account</td>
<td>1081.77%</td>
</tr>
</tbody>
</table>
## Performance Summary: All Trades

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Total Net Profit</td>
<td>$166,887.50</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>$393,287.50</td>
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<tr>
<td>Open position P/L</td>
<td>$1,762.50</td>
</tr>
<tr>
<td>Gross Loss</td>
<td>($226,400.00)</td>
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<tr>
<td>Total # of trades</td>
<td>313</td>
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<tr>
<td>Number winning trades</td>
<td>120</td>
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<tr>
<td>Percent profitable</td>
<td>38.34%</td>
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<tr>
<td>Number losing trades</td>
<td>193</td>
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<tr>
<td>Largest winning trade</td>
<td>$24,475.00</td>
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<td>Average winning trade</td>
<td>$3,277.40</td>
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<tr>
<td>Largest losing trade</td>
<td>($2,625.00)</td>
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<td>Average losing trade</td>
<td>($1,173.06)</td>
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<tr>
<td>Ratio avg win/avg loss</td>
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<tr>
<td>Avg trade (win &amp; loss)</td>
<td>$533.19</td>
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<tr>
<td>Max consec. Winners</td>
<td>5</td>
</tr>
<tr>
<td>Avg # bars in winners</td>
<td>36</td>
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<tr>
<td>Max consec. losers</td>
<td>7</td>
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<td>Avg # bars in losers</td>
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<td>Max intraday drawdown</td>
<td>($14,925.00)</td>
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<td>Profit Factor</td>
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<tr>
<td>Max # contracts held</td>
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</tr>
<tr>
<td>Account size required</td>
<td>$14,925.00</td>
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<tr>
<td>Return on account</td>
<td>1118.17%</td>
</tr>
</tbody>
</table>
# 6 Year EC Performance


## Performance Summary: All Trades

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>Total Net Profit</td>
<td>$79,825.00</td>
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<tr>
<td>Gross Profit</td>
<td>$122,062.50</td>
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<tr>
<td>Open position P/L</td>
<td>$875.00</td>
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<tr>
<td>Gross Loss</td>
<td>($42,237.50)</td>
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<tr>
<td>Total # of trades</td>
<td>50</td>
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<tr>
<td>Number winning trades</td>
<td>24</td>
</tr>
<tr>
<td>Percent profitable</td>
<td>48.00%</td>
</tr>
<tr>
<td>Number losing trades</td>
<td>26</td>
</tr>
<tr>
<td>Largest winning trade</td>
<td>$13,800.00</td>
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<tr>
<td>Average winning trade</td>
<td>$5,085.94</td>
</tr>
<tr>
<td>Largest losing trade</td>
<td>($4,875.00)</td>
</tr>
<tr>
<td>Average losing trade</td>
<td>($1,624.52)</td>
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<tr>
<td>Ratio avg win/avg loss</td>
<td>3.13</td>
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<tr>
<td>Avg trade (win &amp; loss)</td>
<td>$1,596.50</td>
</tr>
<tr>
<td>Max consec. Winners</td>
<td>3</td>
</tr>
<tr>
<td>Max consec. losers</td>
<td>2</td>
</tr>
<tr>
<td>Avg # bars in winners</td>
<td>45</td>
</tr>
<tr>
<td>Avg # bars in losers</td>
<td>16</td>
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<tr>
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<td>($7,875.00)</td>
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<td>Profit Factor</td>
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<td>Account size required</td>
<td>$7,875.00</td>
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<tr>
<td>Max # contracts held</td>
<td>1</td>
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<tr>
<td>Return on account</td>
<td>1013.65%</td>
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</table>
The System Works on ETFs

Performance Summary: All Trades

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Net Profit</td>
<td>$8,665.00</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>$14,266.00</td>
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<tr>
<td>Total # of trades</td>
<td>33</td>
</tr>
<tr>
<td>Number winning trades</td>
<td>12</td>
</tr>
<tr>
<td>Largest winning trade</td>
<td>$4,940.00</td>
</tr>
<tr>
<td>Average winning trade</td>
<td>$1,188.83</td>
</tr>
<tr>
<td>Ratio avg win/avg loss</td>
<td>4.38</td>
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<tr>
<td>Max consec. Winners</td>
<td>3</td>
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<tr>
<td>Avg # bars in winners</td>
<td>86</td>
</tr>
<tr>
<td>Max intraday drawdown</td>
<td>($2,288.00)</td>
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<tr>
<td>Profit Factor</td>
<td>2.50</td>
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<tr>
<td>Account size required</td>
<td>$2,288.00</td>
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<tr>
<td>Open position P/L</td>
<td>$232.00</td>
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<tr>
<td>Gross Loss</td>
<td>($5,701.00)</td>
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<tr>
<td>Percent profitable</td>
<td>36.36%</td>
</tr>
<tr>
<td>Number losing trades</td>
<td>21</td>
</tr>
<tr>
<td>Largest losing trade</td>
<td>($413.00)</td>
</tr>
<tr>
<td>Average losing trade</td>
<td>($271.48)</td>
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<tr>
<td>Avg trade (win &amp; loss)</td>
<td>$259.55</td>
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<tr>
<td>Max consec. losers</td>
<td>6</td>
</tr>
<tr>
<td>Avg # bars in losers</td>
<td>18</td>
</tr>
<tr>
<td>Max # contracts held</td>
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<tr>
<td>Return on account</td>
<td>374.34%</td>
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</table>

Object Lesson:
You can’t make money unless the market moves
The System Works on Stocks, Too

<table>
<thead>
<tr>
<th></th>
<th>CSCO</th>
<th></th>
<th>RTN</th>
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<tbody>
<tr>
<td></td>
<td>All Trades</td>
<td>Long Trades</td>
<td>Short Trades</td>
<td>All Trades</td>
</tr>
<tr>
<td>Total Net Profit</td>
<td>$8,348.00</td>
<td>$5,093.00</td>
<td>$3,255.00</td>
<td>$3,980.00</td>
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<tr>
<td>Gross Profit</td>
<td>$12,873.00</td>
<td>$7,775.00</td>
<td>$5,098.00</td>
<td>$4,366.00</td>
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<tr>
<td>Gross Loss</td>
<td>($4,525.00)</td>
<td>($2,682.00)</td>
<td>($1,843.00)</td>
<td>($386.00)</td>
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<td>Profit Factor</td>
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<td>2.9</td>
<td>2.77</td>
<td>11.31</td>
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<td>Open Position P/L</td>
<td>$42.00</td>
<td>$42.00</td>
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<td>($243.00)</td>
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<td>Total Number of Trades</td>
<td>72</td>
<td>36</td>
<td>36</td>
<td>15</td>
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<tr>
<td>Percent Profitable</td>
<td>45.83%</td>
<td>58.33%</td>
<td>33.33%</td>
<td>66.67%</td>
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<tr>
<td>Winning Trades</td>
<td>33</td>
<td>21</td>
<td>12</td>
<td>10</td>
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<tr>
<td>Losing Trades</td>
<td>37</td>
<td>15</td>
<td>22</td>
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<tr>
<td>Even Trades</td>
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<tr>
<td>Avg. Trade Net Profit</td>
<td>$115.94</td>
<td>$141.47</td>
<td>$90.42</td>
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<td>Avg. Winning Trade</td>
<td>$390.09</td>
<td>$370.24</td>
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<td>Avg. Losing Trade</td>
<td>($122.30)</td>
<td>($178.80)</td>
<td>($83.77)</td>
<td>($96.50)</td>
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<td>Largest Winning Trade</td>
<td>$4,320.00</td>
<td>$4,179.00</td>
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<td>Largest Losing Trade</td>
<td>($437.00)</td>
<td>($437.00)</td>
<td>($241.00)</td>
<td>($215.00)</td>
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<td>Max. Consecutive Winning</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>4</td>
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<td>Max. Consecutive Losing</td>
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<tr>
<td>Avg. Bars in Total Trades</td>
<td>53.56</td>
<td>72.83</td>
<td>34.28</td>
<td>56.07</td>
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<td>Avg. Bars in Winning Trade</td>
<td>87.73</td>
<td>105.1</td>
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<td>71.7</td>
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<td>Avg. Bars in Losing Trade</td>
<td>25.16</td>
<td>27.67</td>
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<td>Avg. Bars in Even Trades</td>
<td>15</td>
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<td>33</td>
</tr>
<tr>
<td>Trading Period</td>
<td>15 Yrs, 10 Dys</td>
<td>3 Yrs, 9 Mths, 17 Dys</td>
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<td>Max. Equity Run-up</td>
<td>$10,025.00</td>
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<td>$4,661.00</td>
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<td>Date of Max. Equity Run-up</td>
<td>4/4/2001 13:00</td>
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<td>12/1/2004 13:00</td>
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<tr>
<td>Max. Drawdown (Intra-day Peak to Valley)</td>
<td>($2,694.00)</td>
<td>($3,027.00)</td>
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<td>Date</td>
<td>4/14/2000 13:00</td>
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<td>5/9/2005 13:00</td>
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<td>Max. Drawdown (Trade Close to Trade Close)</td>
<td>($1,633.00)</td>
<td>($1,558.00)</td>
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<td>Date</td>
<td>2/7/2003 13:00</td>
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<td>9/24/2003 13:00</td>
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</table>

This is an independent presentation not affiliated with TradeStation.
• Eight (or more) systems can be created using NonLinear Moving Averages as a basis
• The systems have four components
  – NonLinear Moving Average
  – Time Event
  – Volatility Histeresis
  – Loss Escape Mechanism
• The systems are robust over long time spans
• The systems are robust over vastly different trading instruments