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Improve Trading Performance With A Whipsaw Filter

Taming The Effects Of Whipsaw

By filtering market whipsaw, the trading performance of a trend-following strategy could be greatly improved. Here's how.

Trend-following strategies are most profitable when they identify trending movement as early as possible. But, because trends sometimes abruptly end and then reverse due to market whipsaw, these strategies become less profitable. The overall price change in the whipsaw region may be relatively small, but price variations within the region can be large. As a result, trend-following strategies create false entry signals. To address this problem, we will show how to characterize whipsaw data and design a whipsaw filter to reduce false entry signals.

Market whipsaw is usually described as a single strong movement in one direction followed by an equally strong reversal. This is often seen during a breakout from a low volatility period. However, during volatile market conditions and especially for smaller timeframes, whipsaw patterns may occur containing multiple up and down price swings. As a result, trend-following strategies can be fooled and produce a string of losing trades. A whipsaw filter is needed to reduce false entry signals from multiple whipsaw price swings.

What's ahead

In the following sections, we'll examine the characteristics of whipsaw and trend price data. With the help of a zigzag indicator, we identify properties of zigzag patterns useful for modeling whipsaw behavior and designing a whipsaw filter.

Trading performance is measured using a rudimentary trading strategy along with a whipsaw filter. Using a MetaTrader expert advisor in a trade simulator, we can measure the trading performance for several currency pairs in the forex market and evaluate the effectiveness of the whipsaw filter.

Example whipsaw pattern

First, let's look at a typical whipsaw pattern containing multiple price swings.

Figure 1 shows a price chart for one-hour EURUSD forex data. An upward trend of magnitude 90 pips and six-hour duration is followed by a whipsaw region of 40-hour duration. The total variation in the whipsaw region is approximately 45 pips. A zigzag pattern, with a threshold of 15 pips, is overlaid on the price data. The threshold parameter controls the zigzag movement and determines when to create a new zigzag segment in the opposite direction. For an uptrend zigzag segment, when the closing price drops below the highest close minus the threshold, the upward segment is ended and a new downward

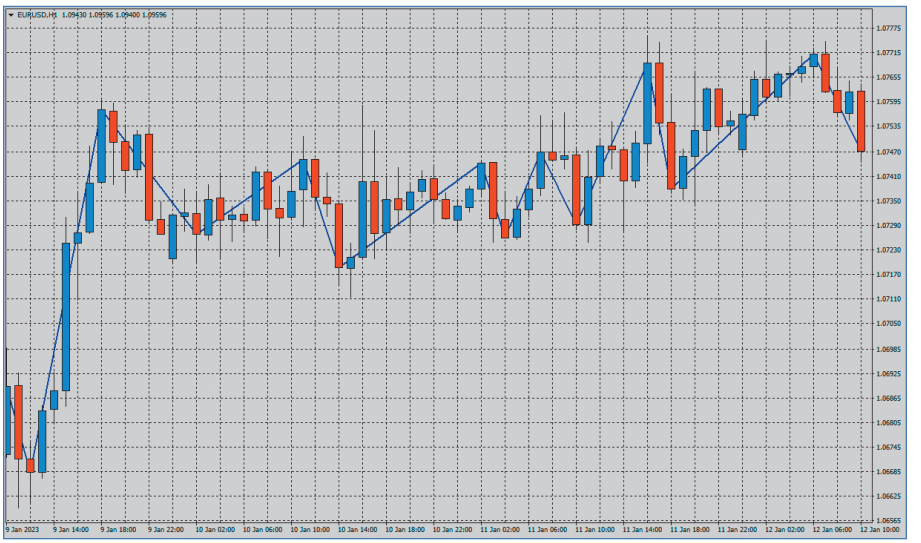

FIGURE 1: EURUSD H1 WHIPSAW EXAMPLE. A short uptrend is followed by a longer whipsaw region. A zigzag pattern is overlaid on the data.

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by Richard Poster, PhD

segment is formed.

RATE OF DIRECTIONAL CHANGE (RODC) INDICATOR

A whipsaw pattern has alternating up and down zigzag segments within a specific window size. The number of zigzag segments in a window is equivalent to a rate of directional change (RODC).

$$RODC = 100^* \# Segments / Window\ size\ (bars)\ 0. \leq RODC < 100 \quad \textbf{Eq. 1}$$

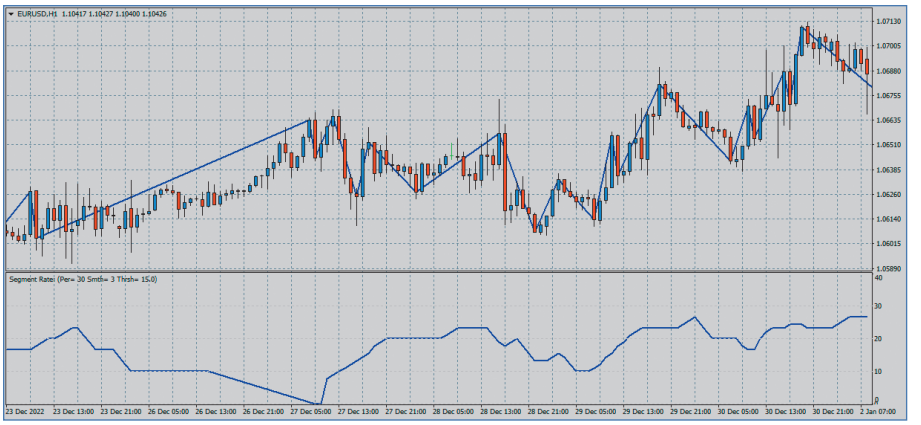


FIGURE 2: RODC INDICATOR. The RODC decreases during trending conditions and increases during whipsaw conditions.

The RODC indicator uses equation 1 and measures the number of directional changes per 100 bars.

Figure 2 shows the indicator in regions of trending and whipsaw. Larger values of the RODC match whipsaw regions while smaller values match trending regions.

Code for the RODC indicator in the MetaQuotes language for MetaTrader is displayed in the sidebar, "Rate Of Directional Change (RODC) Smoothed Indicator, In MetaQuotes."

You can find more detailed studies of the properties of zigzag price data in two of my previous articles in this magazine, which are listed at the end in the "Further reading" section.

IMPLEMENTING A WHIPSAW FILTER

The whipsaw filter is based on the RODC indicator. It uses two inputs from the RODC indicator:

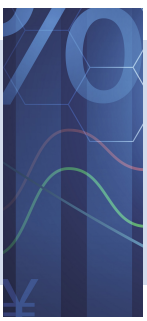
- Zigzag threshold (pips)
- Zigzag window (bars)

The whipsaw filter utilizes two properties of the zigzag price data:

- Number of up and down segments in the window (RODC).
- Total return from first bar to last bar in the window (pips).

$$Return\ size = (CLOSE_{LAST} - OPEN_{FIRST}) \quad \textbf{Eq. 2}$$

In a specific window, a small return size and large RODC value characterize whipsaw price movement. An effective filter will use a lower limit for the return size and an upper limit for the RODC to remove whipsaw data.



We will show how to characterize whipsaw data and design a whipsaw filter to reduce false entry signals.

MODELING AND ANALYZING WHIPSAW AND TREND DATA

An analysis of price data is necessary in order to assess the feasibility of using a zigzag pattern to identify and filter whipsaw price movement. The analysis uses closing price data from the one-hour EURUSD chart.

First, we define some terms used in the analysis.

Terms:

- Zigzag threshold—For an upward segment, the amount (pips) of downward change from the highest point of the segment before a new downward segment is declared. Vice a versa for a downtrend segment.
- Return size—The price change (pips) of a bar, zigzag segment, or whipsaw group.
- Segment—A leg of a zigzag pattern. Represents an upward or downward price swing. It is described by the return size (pips) and duration (bars).
- Trend—A single segment of a zigzag pattern. It is described by the total return size and duration of the segment. Average return size and duration depend on the zigzag threshold.
- Whipsaw group (WSG)—Contains two or more zigzag segments. It is measured by the total return size of the group (pips), duration (bars) of the group, and the maximum segment size (pips) within the group.

Next, we define the criteria used in the model for designating a collection of closing price data as a whipsaw group or as a trend segment. The model uses four input parameters.

Model input parameters:

1. WSG segment threshold—Maximum return size allowed for any segment within the WSG.
2. WSG return threshold—Maximum return size allowed for the WSG.
3. Zigzag threshold—Defines the minimum amount of change required to reverse direction in the zigzag pattern.
4. Zigzag window—Number of bars being examined.

Criteria for identifying a whipsaw group:

- A WSG has two or more segments.
- The WSG return size is small and has an absolute value less than the WSG return threshold.
- All WSG segments have an absolute value less than the WSG segment threshold.

Criteria for identifying a trend:

- The total return size has an absolute value greater than the WSG segment threshold. A trend is always defined as one zigzag segment.

Modeling and analysis is focused on answering the following key questions:

1. What is the average number of zigzag segments (RODC) in whipsaw groups?
2. What is the average duration (bars) of whipsaw groups and trend segments?
3. How often do bars from whipsaw groups and trend segments occur?
4. What is the optimal zigzag threshold size?
5. What are the optimal input values to the model for separating trend and whipsaw data?

1. Average number of zigzag segments (RODC)

Figure 3 shows the average number of zigzag segments per 100 bars (RODC) for whipsaw group data, for all data and for trend data as a function of zigzag threshold. The

The rate of directional change (RODC) helps separate trend and whipsaw data.

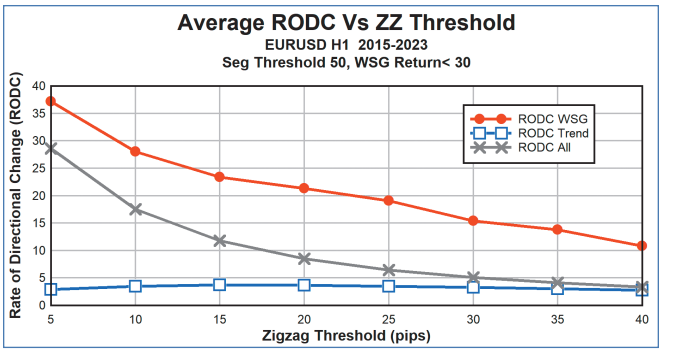


FIGURE 3: RATE OF DIRECTIONAL CHANGE (RODC). Trend and whipsaw data have a large RODC separation.

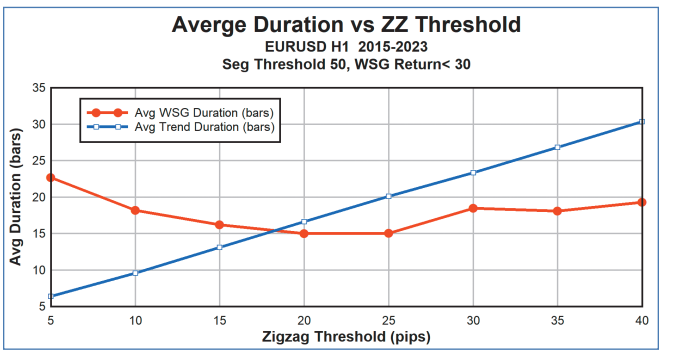


FIGURE 4: AVERAGE DURATION OF TRENDS AND WHIPSAW GROUPS. Whipsaw groups have an average duration of 15 to 23 bars.

RODC calculations for the three data types are:

$$\text{RODC WSG} = 100 * \Sigma\,[\text{WSG segments}] / \Sigma\,[\text{WSG duration (bars)}]$$

$$\text{RODC trend} = 100 * \text{Total trend segments} / \text{Total bars}$$

$$\text{RODC all} = 100 * \text{Total segments} / \text{Total bars}$$

A WSG segment threshold (maximum) of 50 pips and a WSG return threshold (maximum) of 30 pips are used in the model. Trend segment size must exceed 50 pips. Larger zigzag thresholds result in fewer segments in the whipsaw group.

The average WSG RODC is always larger than the average RODC for all data. For a zigzag threshold of 10 pips, the average WSG RODC is 27.8 and the average trend RODC is 3.6. For a zigzag threshold of 20 pips, the average WSG RODC is 21.4 and the average trend RODC is 3.9. The RODC provides a clear separation between whipsaw and trend data.

2. Average WSG duration

Figure 4 shows the average duration (bars) for whipsaw groups and trend segments as a function of zigzag threshold. The average trend duration increases linearly with increasing zigzag threshold. The average WSG duration sets the minimum size of the window of the whipsaw filter.

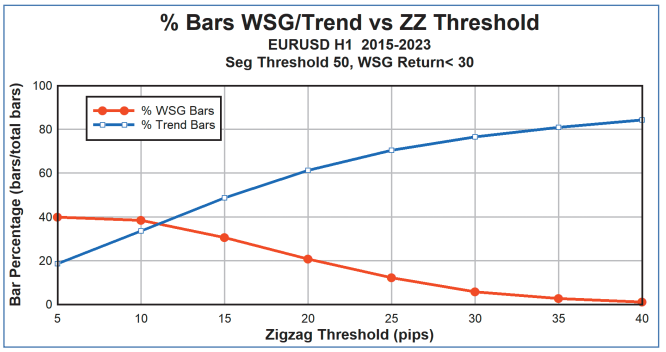


FIGURE 5: CONTRIBUTION OF TREND AND WHIPSAW BARS. As the zigzag threshold increases, the number of bars from trend segments increases and the number of bars from WSGs decreases.

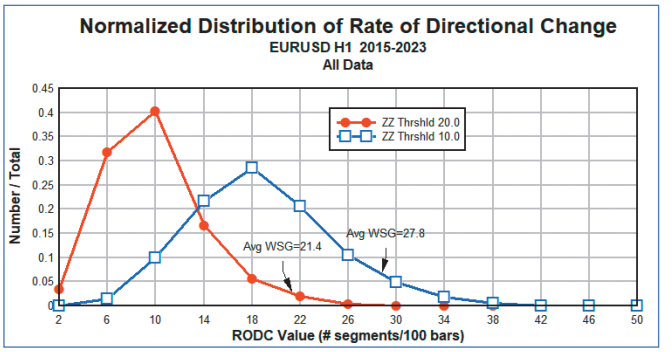


FIGURE 6: DISTRIBUTION OF RODC. The RODC distribution has a significant spread and increases with decreasing threshold. Average WSG RODCs are shown for zigzag thresholds of 10 and 20 pips.

At a zigzag threshold of 20 pips, the average WSG duration is 15.3 bars. From Figure 3, the corresponding RODC is 21.4. Multiplying these two values and dividing by 100 gives an average of 3.3 segments per WSG.

3. Rate of occurrence of trends and whipsaw groups

Figure 5 shows the rate of occurrence of bars belonging to trend segments and whipsaw groups as a function of the zigzag threshold. At a zigzag threshold of 20 pips, the bars from WSGs make up 20.8% of the total bars while trend bars make up 62.5% of the total bars.

4. Optimal zigzag threshold size

From inspection of price charts, large zigzag thresholds (> 50 pips) will be insensitive to whipsaw, while small thresholds (< 5 pips) will be insensitive to long trends. For a WSG segment threshold of 50 pips, Figures 3 and 5 suggest that a zigzag threshold of 10–20 pips is best, since both whipsaw and trend data are visible. While ranging data produces large RODC values for small thresholds, this data can be easily removed by volatility filters and careful selection of the zigzag threshold.

5. Optimal input values for model and filter

Figure 6 shows the general RODC distribution for zigzag thresholds of 10 and 20 pips. Smaller zigzag thresholds have a larger average RODC and have a wider distribution spread than larger thresholds. This suggests that smaller zigzag thresholds are preferable for the filter.

From the discussion of Figure 3, average WSG RODC values of 21.4 and 27.8 are found for zigzag thresholds of 20 and 10 pips. These values fall on the tails of their respective RODC distributions in Figure 6. Since smaller average RODC values occur for trending regions (< 5) and larger average values occur for whipsaw regions (> 20), the whipsaw filter will use an upper limit of the RODC to reduce the effects of whipsaw.

The inputs to the whipsaw model are a good starting point for testing a whipsaw filter in an expert advisor.

TRADING PERFORMANCE WITH THE WHIPSAW FILTER

We use a simple, trend-following strategy to estimate profit performance. This strategy, on its own, would not support a profitable trading system but is useful to demonstrate the performance of the whipsaw filter.

The strategy for long trades requires a fast moving average to be above a slow moving average by a specified threshold amount (pips). Similarly, the strategy for short trades requires a fast moving average to be below a slow moving average by the same threshold amount. The fast moving average period is 1–4 bars. Other rules for entry or exit signals are:

- Only one trade can be open at a time.
- Bollinger Band separation is within lower and upper bounds.
- Take-profit, stop-loss, and trailing-stops are used to exit trades.
- The maximum lifetime (bars) of an open trade is fixed.
- New buy signals cause open short positions to be closed and vice versa.

After a trade signal is generated, zigzag pattern properties are used to filter the data. The zigzag pattern has a specific

The whipsaw filter is based on the rate of directional change (RODC) indicator.

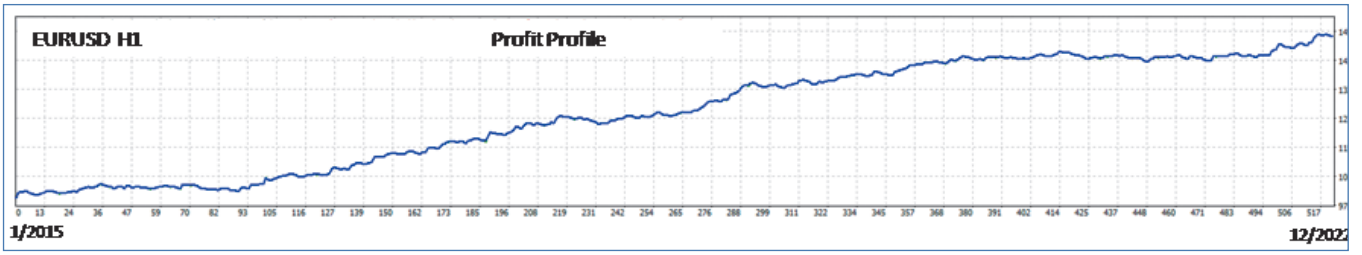


FIGURE 7: PROFIT PROFILE FOR EURUSD. Backtesting of the expert advisor shows a steady gain over an eight-year period.

window size and threshold. The filter logic is:

- Place an upper limit on the allowed number of up and down zigzag segments (RODC).
- Place a lower limit on the total return size for the zigzag window (equation 2).

Five currency pairs have been evaluated over a period of 2015–2022 with one-hour charts. As an example, Figure 7 shows the profit profile for the EURUSD pair using the described trading strategy with a whipsaw filter. With a lot size of 0.10, a profit of $4,845 is realized for 521 trades.

For the EURUSD pair, the optimal zigzag threshold is 10 pips. The corresponding RODC threshold is 16.

Test results for five currency pairs, with and without use of the whipsaw filter, are shown in Figure 8. Performance results are measured by the profit factor (profit/loss) and payoff (average profit per trade). In every case, the whipsaw filter improves the profitability of the trend-following strategy.

Currency Pair	# Trades	Profit (0.1 Lot)	Profit Factor	Payoff
EURUSD—No Filter	1938	$6800	1.24	3.51
EURUSD—WS Filter	521	$4845	1.73	9.30
GBPUSD—No Filter	541	$1584	1.25	2.93
GBPUSD—WS Filter	468	$2743	1.54	5.28
USDCAD—No Filter	372	$1296	1.44	3.24
USDCAD—WS Filter	317	$1329	1.62	4.20
USDCHF—No Filter	401	$5466	2.00	13.63
USDCHF—WS Filter	329	$5127	2.27	15.59
USDJPY—No Filter	1098	$5652	1.32	5.15
USDJPY—WS Filter	807	$5852	1.51	7.23

FIGURE 8: PROFIT PERFORMANCE SUMMARY. In every case, the whipsaw filter improves the profitability of the trend-following strategy.

Conclusions

- The rate of directional change increases during market whipsaw and decreases during market trending.
- The RODC helps separate trend and whipsaw data.
- Bars from multi-segment whipsaw groups occur often.
- Using a zigzag pattern and the RODC indicator, the whipsaw filter improves the performance of a rudimentary trend-following strategy.

The RODC decreases during trending conditions and increases during whipsaw conditions.

The code provided with this article is available in the S&C Article Code section of Traders.com.

*See our **Traders' Tips** coding section beginning on page 46 for additional code related to this topic, prepared for popular technical analysis programs and trading platforms. The code in that magazine section can also be found in the Traders' Tips section of Traders.com.*

Further Reading

Poster, Richard [2020]. "Using Scaling Laws For The Development Of FX Trading Models," *Technical Analysis of* Stocks & Commodities, Volume 38: February.

_____ [2020]. "Using Scaling Laws For FX Trading Models: A Two-Dimensional Extension," *Technical Analysis of* Stocks & Commodities, Volume 38: July.

Richard Poster, PhD, has been designing and implementing FX trading models for more than a decade along with private forex trading. He has a PhD in physics and has used the many techniques and methodologies from his experience in elementary particle physics research and later developing electronic warfare systems. He is interested in applying neural networks, fuzzy logic, fractal analysis, and quantum mechanics to forex trading models. He may be reached at raposterbnl@gmail.com.

RATE OF DIRECTIONAL CHANGE (RODC) SMOOTHED INDICATOR, IN METAQUOTES

```
//+------------------------------------------------------------------+
//|            RODCSmoothdInd.mq4 |
//|            Copyright 2023–2024, Richard Poster |
//+------------------------------------------------------------------+
// chart 100.*(Number of segments/window Length)
// Rate of Directional Change (RODC)
#property copyright "2023, R. Poster"
#property link     "http://www.mql4.com"
#property strict
#property description "RODC based on zigzag"
//
#property indicator_separate_window
#property indicator_buffers 1
#property indicator_color1  clrBlue

//---- indicator parameters
input int    BkData   = 30;  // Window
input double Lamda    = 15.;  // Zigzag Threshold
input int    PerSmth  =  3;  // Smooth Period

//---- indicator buffers
double ExtZigzagBuffer[],SmthBuffer[];
//--- globals
double      _point;
int         _digits;
string      _symbol;
double      MULT;
double      LamUp,LamDn;

//+------------------------------------------------------------------+
//| Custom indicator initialization function                         |
//+------------------------------------------------------------------+
int OnInit()
 {
  _symbol=Symbol();   // set symbol
  _point = MarketInfo(_symbol,MODE_POINT);
  _digits= int(MarketInfo(_symbol,MODE_DIGITS));
  MULT=1.0;
  if(_digits==5 || _digits==3)
    MULT=10.0;
    LamUp = Lamda;
    LamDn = Lamda;
  IndicatorBuffers(2);
  IndicatorSetDouble(INDICATOR_MINIMUM,0.);
  IndicatorSetDouble(INDICATOR_LEVELVALUE,1,10.);
  IndicatorSetDouble(INDICATOR_LEVELVALUE,2,20.);
  IndicatorSetDouble(INDICATOR_LEVELVALUE,3,30.);
//---- drawing settings
  SetIndexStyle(0,DRAW_SECTION,EMPTY,2);
//---- indicator buffers
  SetIndexBuffer(1,ExtZigzagBuffer);
  SetIndexBuffer(0,SmthBuffer);
  SetIndexEmptyValue(0,0.0);
//---- indicator short name
  IndicatorShortName("Segment Rate: (Per=
"+IntegerToString(BkData)+
               " Smth= "+IntegerToString(PerSmth)+ " Thrsh= "+
               DoubleToString(Lamda,1)+") ");
  ArraySetAsSeries(ExtZigzagBuffer,false);
  ArraySetAsSeries(SmthBuffer,false);
//---- initialization done
  return(INIT_SUCCEEDED);
 }
//+------------------------------------------------------------------+
//|                                                                  |
//+------------------------------------------------------------------+
int OnCalculate(const int rates_total,
           const int prev_calculated,
           const datetime &time[],
           const double &open[],
           const double &high[],
           const double &low[],
           const double &close[],
           const long& tick_volume[],
           const long& volume[],
           const int& spread[])
 {
  int i,jj,limit;
  int AryUD[150];
  int NumUp,NumDn,NumUD,Strt,jext;
  bool modeUp;
  double xext,xcls;
  int segstr;
  int nUp,nDn,nUD;
//-----
  ArraySetAsSeries(close,false);

//---- first calculations
  if(prev_calculated==0)
   {
    limit=BkData+PerSmth+1;
    for(i=0;i<limit;i++)
     {
      ExtZigzagBuffer[i] = 100./BkData; // set first values of
buffer
     }
   }
  else
   limit=prev_calculated-1;

//---- main loop
  for(i=limit; i<rates_total; i++)
   {
 // ---- init
    nUp=1;  // assume starting in mode up
    nDn=0;
    nUD = 1;
    modeUp = true;  // starting value
    ArrayInitialize(AryUD,0);
 // default for first segment
    segstr = i-BkData+1;
    Strt = i;
    //
    AryUD[0] =     segstr;  // start of first (up mode) segment
    xext = close[segstr-1];   // first time
    jext = segstr-1;
 //  -------- store bar arrays ------
    for(jj=segstr;jj<=Strt;jj++)
     {
      xcls = close[jj];
      if(!modeUp)  // mode down
       {
```

RATE OF DIRECTIONAL CHANGE (RODC) SMOOTHED INDICATOR, IN METAQUOTES

```
      if(xext > xcls) // still mode down
       {
       xext = xcls;
       jext = jj;
      }
      else
      if((xcls-xext)/(MULT*_point) >= LamDn) // reverse to
mode up
       {
        modeUp=true;
        nUp +=1;              // increment up mode counter for
new mode
        nUD +=1;              // increment mode counter
        AryUD[nUD-1] = jext;
        xext = xcls;
        jext = jj;
     // starting bar of mode
       }
     } //----  end if !modeUp ----------
     else
      if(modeUp)
      {
       if(xext < xcls) // still mode up
        {
         xext = xcls;
         jext = jj;
        }
       else
       if((xcls-xext)/(MULT*_point) <= -LamUp) // reverse to
mode down
        {
         modeUp=false;
         nDn +=1;             // increment down mode counter
for new mode
         nUD += 1;            // increment mode counter
         AryUD[nUD-1] = jext;       // starting bar of mode
         xext = xcls;
         jext = jj;
        }
      } //------  if modeUp ----------
     }  // ----------- jj loop -----------------
//--------------------------------------------------
     NumUp =  nUp;  //
     NumDn =  nDn;
     NumUD =  nUD;
//   // set buffer
     if(NumUD==0) // trend length > window size
      ExtZigzagBuffer[i] = 100./BkData;
      else
       ExtZigzagBuffer[i]  = 100.*NumUD/BkData;
//-------------------------------------------------------
//----- Smooth buffer
     SmthBuffer[i] = 0.;
     for(jj=0;jj<PerSmth;jj++)
      {
       SmthBuffer[i] += ExtZigzagBuffer[i-jj];
      }
     SmthBuffer[i] = SmthBuffer[i]/PerSmth;
   } // ---------------- end of i loop ------------------------------
-----
//--- done
  return(rates_total);
 }
//+------------------------------------------------------------------+
```

This code listing is also available as a downloadable .mq4 file from the S&C Article Code section of Traders.com.

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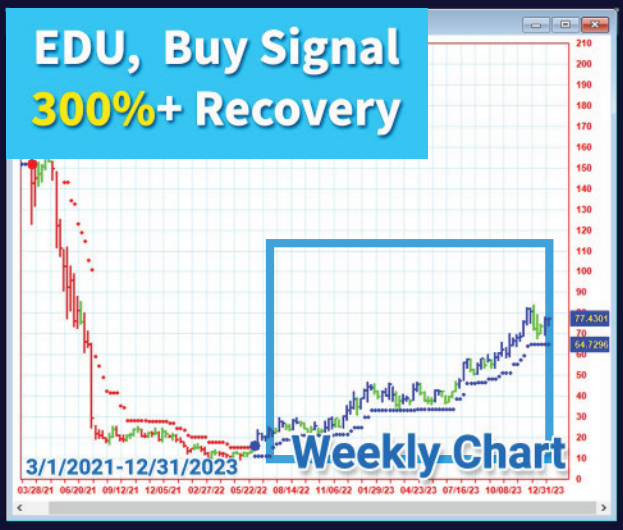

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- "**Have been using Able Trend for 20 years and it is just as effective and accurate as it was in 1999.** I have used it profitably for day trading for futures, just as I have for position trading stocks…Use every day whether trading that day or not. " - Dan Sayyer
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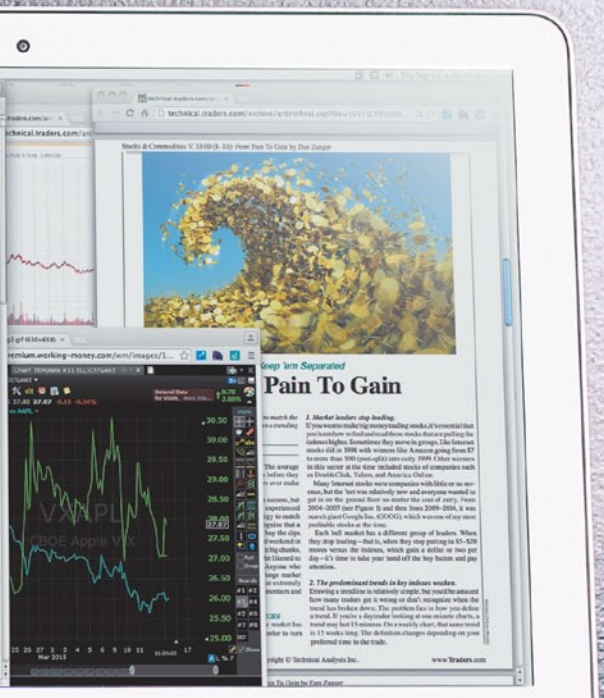

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