Fractal Analysis Indicator Set
For Tradestation
Version 3.0 Advanced
User's Guide

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1 Overview

The BMJ Fractal Analysis Indicator set is a group of indicators based on the concept of the fractal analysis of a time series. All the indicators are based on a common core that takes any time series and analyzes the fractal dimension of the time series. This analysis is based on an algorithm that is designed to estimate the fractal dimension of a time series. It is slightly more complex than the algorithms presented by John Ehlers in *Technical Analysis of Stocks and Commodities* (October, 2005 or June, 2010) and it is slightly less complex than the algorithm used in the Neuroshell Trader indicator for the calculation of fractal dimension (based on Peters, 1994 and 1996).

The fractal dimension for a time period of a given time series is estimated and converted to the Hurst exponent. The relationship between the fractal dimension and the Hurst exponent is such that the Hurst exponent is equal to two minus the fractal dimension. The fractal dimension varies between 1 and 2 while the Hurst exponent varies between 0 and 1. A time series with a Hurst exponent of 0.5 is said to be random, approximating Brownian motion. A time series with a Hurst exponent greater than 0.5 is said to be persistent, it will tend to travel far, but eventually it will reverse. A time series with a Hurst exponent less than 0.5 is said to be anti-persistent, it will travel less, and it will change direction more frequently. A persistent time series can generally be expected to continue in the direction of the trend, at least until it reverses. An anti-persistent time series will generally not be in a trend and may be expected to reverse direction more frequently. A time series with a Hurst exponent greater than 0.5 would generally be characterized as a trending market, while a time series with a Hurst exponent less than 0.5 would generally be characterized as a trading or cycling market. Any financial instrument and any financial time series can be expected to exhibit both forms of behavior over time.

The theory of the fractal analysis indicators is that by using the fractal dimension and the Hurst exponent we can produce filtered time series that are theoretically stripped of most of the noise in the data. The result is really two foundational indicators upon which all others are developed. The first is the BMJ Hurst indicator which is the calculated Hurst exponent for some look back window in the time series. The second is the BMJ FFFilter or the fractal filter. The fractal filter is developed by using the Hurst exponent and converting it to an alpha for an adaptive filter of the time series based on the concept that price variation is directly proportional to some power of the time elapsed (as described by Mandelbrot, 2004 and others).

We might be tempted to call this an adaptive moving average. But it is really much more than that. The fractal filtered time series is so responsive to changes in direction with virtually no lag and no overshoot, that the filtered result can be used as a proxy for the original time series in any traditional technical analysis techniques. The result is a highly responsive smoothing filter of any data series.

The BMJ Fractal Filter can be used as a pre-processor of the time series for any traditional technical analysis. It can also be used as a post-processor to smooth traditional technical analysis techniques or to provide a signal line for cross over triggers. The BMJ Fractal Analysis indicators can also be used in concert with other traditional technical analysis indicators. All three of these approaches are illustrated in the Example Charts.

References:
2 Where to Find the Fractal Indicators

You will import the indicators into Tradestation as described in the Read Me file found in the C:\BMJ Fractal Analysis Tradestation folder.

Once you have installed the BMJ Fractal Analysis Indicator Set, you may add any of the new indicators to your chart by selecting the Insert Analysis Technique from the Insert menu item or by right clicking in the chart window. The BMJ Indicators will be displayed on the list of indicator on the Indicator Tab. All of the BMJ Indicators begin with the prefix BMJ so they will all be listed together. After you select the indicator and click on the OK button, the indicator will be added to your chart just as you would any other Tradestation indicator. If you check the box Prompt for Format, the indicator will be opened for formatting before being inserted onto your chart.

3 Where to Find the Example Charts

Once you have installed the BMJ Fractal Indicator Set you will be able to load and examine the Example Charts. You will find the Example Charts located in the default C:\BMJ Fractal Analysis Tradestation folder. The Example Charts are installed by default in a folder called BMJ Fractal Analysis Examples contained within the default folder. You may open the example charts from this folder. You may also copy the example chart folder to your MyWork folder if you would find that more convenient.

4 The Included Indicators & Functions

The indicators included with the BMJ Fractal Analysis Indicator Set have evolved through two previous versions. Version 3.0 is the most current version included with this indicator set. There are nine indicators included in this indicator set. These indicators are described in a little more detail in a section that follows.

There are also four functions that are made available in this indicator set. These can be used in your own indicators and strategies. These functions are also described in a little more detail in a section that follows.

4.1 Version 3.0 Indicators

These are the indicators unique to this indicator set. There are 9 indicators in this category. They are all based, at least in part, on the Fractal Analysis computations described in the Overview. The 3.0 versions of the indicators have the fractal filter and a tuning feature built into the algorithm for the indicators. In this way the BMJ FFilter 30 indicator, the BMJ SFilter 30 indicator, and the BMJ ZLFilter 30 indicator behave very much like a traditional moving average. They respond very quickly to changes in trend, including gaps up and gaps down, while retaining their ability to avoid the overshoot and undershoot experienced by traditional moving averages.

The fractal dimension calculations still provide the fractal filtering, while the built in tuning feature adjusts the filtered result so that it can be used instead of any traditional moving average. And this is the reason that this indicator can be considered as a proxy for price and can be used as an input for any standard indicator that uses a data series as its input - such as a moving average, RSI, Stochastic, or any other of the multitude of standard indicators included with Tradestation.
These indicators are protected and can be opened for inspection. You can, however, use the functions that drive these indicators in your own functions, indicators, or strategies. The functions are described in a section that follows.

4.1.1 BMJ FFilter 30 & HiLo

Inputs:

- Price = some time series (default = close)
- N = period or number of bars for the fractal analysis (default = 30)
- Displace = input for adjusting the output forward or backward in time (default = 0)
- ColorBars = true/false switch to turn coloring of bars on or off (default = True)
- upColor = color for the output when increasing (default = blue)
- downColor = color for the output when decreasing (default = magenta)
- ShowFFBar = true/false switch to determine if the Fractal Filter is displayed on the screen (default = true)
- ShowHiLo = true/false switch to determine if the High and Low bands are displayed (default = false)
- GapUp = multiplier of Fractal Filtered version of ATR to be added to the Fractal Filter
- GapDn = multiplier of Fractal Filtered version of ATR to be subtracted from the Fractal Filter

This is the basic BMJ Fractal Filter based on the technology described in the Overview and the main topics for these indicators. The N period input determines the time period over which the fractal dimension and Hurst exponent of the time series is calculated as well as a tuning factor that together are used in the indicator to filter the data series. You will note that the indicators behave very much like a traditional moving average. The fractal dimension calculations still provide the fractal filtering, while the built in tuning feature adjusts the filtered result so that it can be used instead of any traditional moving average. And this is the reason that this indicator can be considered as a proxy for price and can be used as an input for any standard indicator that uses a data series as its input - such as a moving average, RSI, Stochastic, or any other of the multitude of standard indicators included with Tradestation.

This indicator displays the Fractal Filter on the main sub graph. This indicator is colored by default so that it is displayed blue when increasing and magenta when decreasing. The indicator also provides the ability to add bands above and below the Fractal Filter based on some multiple of the Fractal Filtered version of the ATR. This provides a visual channel that is similar to a Keltner Channel. Both the Fractal Filter and the HiLo bands can be turned on or off by an input switch described above. The Fractal Filter is on by default and the HiLo bands are off by default. The GapUp and GapDn determine the multiplier of the Fractal Filtered version of the ATR that is added to or subtracted from the Fractal Filter. In this way, this indicator differs somewhat from the typical channel because the the GapUp can be a different value from the GapDn. Because markets tend to move down faster than they move up, it is sometimes useful to give more latitude to the lower band. Nevertheless, the default for each is 2.

4.1.2 BMJ Hurst 30

Inputs:

- Price = some time series (default = close)
- N = period or number of bars for the Hurst exponent calculation (default = 30)
The BMJ Hurst 30 indicator displays the results of the Hurst calculation included in the algorithm for the Fractal Filter indicators. This BMJ Hurst 30 indicator goes up (indicating an increase in persistence) in both increasing and declining markets. Since the indicator is computed over some time period, the result is a visual display of the ebb and flow of persistence and anti-persistence over the data series.

4.1.3 BMJ IHurst 30

Inputs:

Price = some time series (default = close)
N = period or number of bars for the Hurst exponent calculation (default = 30)
ColorBars = true/false switch to turn coloring of bars on or off (default = True)
upColor = color for the output when increasing (default = blue)
downColor = color for the output when decreasing (default = magenta)

This indicator is merely the inverse of the BMJ Hurst 30 indicator. IHurst simply stands for InverseHurst. This indicator is useful where the indicators are used together as a visual technical indicator on the chart. Since the IHurst goes down while the Hurst goes up, it is easier to see the changes in trend, persistence, etc. for both rising and declining markets. When shown together they give a good visual depiction of the ebb and flow of persistence and anti-persistence in a time series.

4.1.4 BMJ Hurst Mirror 30

Price = some time series (default = close)
N = period or number of bars for the Hurst exponent calculation (default = 30)
ColorBars = true/false switch to turn coloring of bars on or off (default = True)
upHColor = color for the output when the Hurst is increasing (default = blue)
downHColor = color for the output when the Hurst is decreasing (default = magenta)
upIHColor = color for the output when the IHurst is increasing (default = green)
downIHColor = color for the output when the IHurst is decreasing (default = red)

This indicator is a combination of the BMJ Hurst 30 and the BMJ IHurst 30 indicators. This indicator is useful because the two indicators are used together as a visual technical indicator on the chart. Since the IHurst goes down while the Hurst goes up, it is easier to see the changes in trend, persistence, etc. for both rising and declining markets. When shown together they give a good visual depiction of the ebb and flow of persistence and anti-persistence in a time series.

4.1.5 BMJ SFilter 30 & HiLo

Inputs:

Price = some time series (default = close)
N = period or number of bars for the fractal analysis (default = 30)
Displace = input for adjusting the output forward or backward in time (default = 0)
ColorBars = true/false switch to turn coloring of bars on or off (default = True)
upColor = color for the output when increasing (default = blue)
downColor = color for the output when decreasing (default = magenta)
ShowFFBar = true/false switch to determine if the Fractal Filter is displayed on the screen (default =
true)
ShowHiLo = true/false switch to determine if the High and Low bands are displayed (default = false)
GapUp = multiplier of Fractal Filtered version of ATR to be added to the Fractal Filter
GapDn = multiplier of Fractal Filtered version of ATR to be subtracted from the Fractal Filter

The BMJ SFilter 30 is a slow version of the BMJ FFilter 30. It is constructed by calculating a BMJ FFilter
30 of a BMJ FFilter 30.

The indicator operates identically to the BMJ FFilter 30 indicator. For more information on the use of this
indicator, please see the description of the BMJ FFilter 30 indicator.

4.1.6 BMJ ZLFilter 30 & HiLo

Inputs:

Price = some time series (default = close)
N = period or number of bars for the fractal analysis (default = 30)
Displace = input for adjusting the output forward or backward in time (default = 0)
ColorBars = true/false switch to turn coloring of bars on or off (default = True)
upColor = color for the output when increasing (default = blue)
downColor = color for the output when decreasing (default = magenta)
ShowFFBar = true/false switch to determine if the Fractal Filter is displayed on the screen (default =
true)
ShowHiLo = true/false switch to determine if the High and Low bands are displayed (default = false)
GapUp = multiplier of Fractal Filtered version of ATR to be added to the Fractal Filter
GapDn = multiplier of Fractal Filtered version of ATR to be subtracted from the Fractal Filter

The BMJ ZLFilter 30 is a zero lag version of the BMJ FFilter 30. It is constructed by calculating the
difference between the BMJ FFilter 30 and the BMJ SFilter 30 and adding it to the BMJ FFilter 30.

The indicator operates identically to the BMJ FFilter 30 indicator. For more information on the use of this
indicator, please see the description of the BMJ FFilter 30 indicator.

4.1.7 BMJ FFilter 30 ATR

Inputs:

Price = some time series (default = close)
N = period or number of bars for the fractal analysis (default = 30)
Displace = input for adjusting the output forward or backward in time (default = 0)
ShowSlowATR = true/false switch to determine if the slower version of the indicator is displayed on the
screen (default = true)
ColorBars = true/false switch to turn coloring of bars on or off (default = False)
upColor = color for the output when increasing (default = blue)
downColor = color for the output when decreasing (default = magenta)

This indicator is a Fractal Filtered version of the Average True Range. It was constructed using the
Average True Range as an input to the Price parameter of the BMJ FFilter 30 indicator. This indicator
tends to result in a more smoothed version of the ATR. In addition, the indicator computes a slow version
of the Fractal Filtered version of the ATR by using the Fractal Filter ATR as an input to the BMJ FFilter

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30 function. This presents a visual crossover effect on the screen. This feature is off by default.

### 4.1.8 BMJ FFilter 30 PPO

**Inputs:**

- Price = some time series (default = close)
- N = period or number of bars for the FFilter fractal analysis (default = 30)
- SN = period or number of bars for the SFilter fractal analysis (default = 60)
- Displace = input for adjusting the output forward or backward in time (default = 0)
- ShowSlowPPO = true/false switch to determine if the slow version of the PPO is displayed on the screen (default = true)
- UpColor = color for the output when increasing (default = yellow)
- DnColor = color for the output when decreasing (default = red)
- ColorBars = true/false switch to turn coloring of bars on or off (default = True)
- HiBar1 = first High threshold band to draw on screen to visually determine overbought condition (default = 3)
- LoBar1 = first Low threshold band to draw on screen to visually determine oversold condition (default = -3)
- HiBar2 = second High threshold band to draw on screen to visually determine overbought condition (default = 5)
- LoBar2 = second Low threshold band to draw on screen to visually determine oversold condition (default = -5)
- ShowHiLo1 = true/false switch to determine if the first High and Low bands are displayed (default = false)
- ShowHiLo2 = true/false switch to determine if the second High and Low bands are displayed (default = false)

This indicator is a Fractal Filtered version of the Percent Price Oscillator, which is a percentage version of the MACD. It is based on the percentage difference between the BMJ FFilter 30 and the BMJ SFilter 30 indicators. In other words, it is the difference between the BMJ FFilter 30 and the BMJ SFilter 30 indicators divided by the BMJ SFilter 30 and multiplies by 100 to convert it to a percent. The indicator includes a slow version which is simply the BMJ FFilter 30 PPO used as an input to the BMJ FFilter 30 function. When this is turned on, the indicator also displays a difference of the two PPO’s as a histogram similar the ones displayed by the typical MACD indicator.

### 4.1.9 BMJ FFilter 30 RSI

**Inputs:**

- Price = some time series (default = close)
- N = period or number of bars for the FFilter fractal analysis (default = 7)
- RSILength = period or number of bars for the RSI calculation (default = 14)
- ShowSlowRSO = true/false switch to determine if the slow version of the RSI is displayed on the screen (default = true)
- OverSold = low threshold band to draw on screen to visually determine oversold condition (default = 20)
- OverBought = high threshold band to draw on screen to visually determine overbought condition (default = 80)
- ColorBars = true/false switch to turn coloring of bars on or off (default = True)
- UpColor = color for the output when increasing (default = yellow)
- DnColor = color for the output when decreasing (default = red)
- UpColor2 = color for the slow output when increasing (default = blue)
- DnColor2 = color for the slow output when decreasing (default = magenta)
This indicator is based on the standard Relative Strength Index indicator included with TradeStation using the BMJ FFilter 30 as the input time series. It creates a smoothed RSI that is still responsive to changes in relative strength and momentum. The indicator includes a slow version which is simply the BMJ FFilter 30 RSI used as an input to the BMJ FFilter 30 function. When turned on so that it is displayed on the chart, the result is a crossover indicator which provides visual clues to changes in trend.

### 4.2 Version 3.0 Functions

Each of the Version 3.0 Indicators is based on one or more of the Version 3.0 Functions. The functions are all protected and cannot be opened for inspection. However the function can be used in other functions, indicators, and strategies created by the user. This section describes the parameters of the various functions.

#### 4.2.1 BMJ_FFilter_30_Fn_FNL

\[
\text{BMJ}_\text{FFilter}_\text{30}_\text{Fn}_\text{FNL}(\text{Price}, N)
\]

- \( \text{Price} \) = some time series, such as Close
- \( N \) = period or number of bars for the fractal analysis

#### 4.2.2 BMJ_SFilter_30_Fn_FNL

\[
\text{BMJ}_\text{SFilter}_\text{30}_\text{Fn}_\text{FNL}(\text{Price}, N)
\]

- \( \text{Price} \) = some time series, such as Close
- \( N \) = period or number of bars for the fractal analysis

#### 4.2.3 BMJ_ZLFilter_30_Fn_FNL

\[
\text{BMJ}_\text{ZLFilter}_\text{30}_\text{Fn}_\text{FNL}(\text{Price}, N)
\]

- \( \text{Price} \) = some time series, such as Close
- \( N \) = period or number of bars for the fractal analysis

#### 4.2.4 BMJ_Hurst_30_Fn_FNL

\[
\text{BMJ}_\text{Hurst}_\text{30}_\text{Fn}_\text{FNL}(\text{Price}, N)
\]

- \( \text{Price} \) = some time series, such as Close
- \( N \) = period or number of bars for the fractal analysis

### 5 The Included Example Charts

The Indicator Set includes five example charts. The symbols included in the charts may or may not be enabled as part of your data services. If not, simply add another symbol of your choice and the example will update with the indicators based on your chosen symbol.

#### 5.1 Example 1

**Comparison of BMJ Fractal Filters to Moving Averages**

This example chart of daily bars of GOOG compares the BMJ ZLFilter 30 indicator with various other moving averages. The simple moving average is displayed in cyan. The exponential moving average is displayed in red. The BMJ ZLFilter 30 is displayed in magenta. And the weighted moving average is in
yellow.

The result of the BMJ ZLFilter is a smoothed data series that is faithful to the twists and turns of the original data series. There is very little overshoot or undershoot while responding very quickly to changes in direction, including gaps up and gaps down.

5.2 Example 2

BMJ FFilter with HiLo & RSI

This example chart of daily bars of ES (the emini S&P 500 futures contract) shows the BMJ FFilter 30 indicator with the HiLo bands turned on. The indicator together with the upper and lower bands, can be used to give visual cues to changes in trend.

This chart also includes both the BMJ FFilter 30 RSI indicator and the standard RSI indicator for comparison. The BMJ FFilter 30 RSI version tends to be smoother and tends to be more representative of the strength of the trend for a given data series, while still displaying the divergence between the RSI and price that tends to occur at the end of a trend.

5.3 Example 3

BMJ FFilters with Hurst Mirror & BMJ ATR

This daily chart of SPY is an example of the three BMJ Fractal Filter indicators working together on the main sub-graph. Since the BMJ SFfilter 30 indicator and the BMJ ZLFilter 30 indicator are derivations of the BMJ FFilter 30 indicator, they behave in a similar fashion. The BMJ SFfilter 30 indicator is simply a slower version and the BMJ ZLFilter 30 indicator is a zero lag version. They crossover each other at a single point, providing timely suggestions of changes in trend.

Also included on this chart is the BMJ Hurst Mirror 30 indicator. This indicator presents the calculated Hurst exponent over some look back period. Both the BMJ Hurst 30 indicator and the BMJ IHurst 30 indicator are presented together in this indicator. Also presented is a slower version of each together with the difference between the two shown as a histogram. The results of the BMJ Hurst 30 calculations and the BMJ IHurst 30 calculations were normalized by subtracting 0.5 which represents the demarcation line between persistence and anti-persistence for the Hurst exponent. When the BMJ Hurst 30 portion of the indicator is above 0, the data series is demonstrating persistence. Likewise, when the BMJ IHurst 30 portion of the indicator is below 0, the data series is demonstrating persistence. When the opposite is true the data is demonstrating anti-persistence. This indicator gives a nice visual representation of the ebb and flow of the data series between persistence and anti-persistence over time.

And the final indicator illustrated in this example chart is the BMJ FFilter 30 ATR. This is simply a Fractal Filtered version of the Average True Range. This indicator also includes a slower version that can be displayed on the screen to identify changes in the relative range of the data series.

5.4 Example 4

BMJ ZLFilter with HiLo & PPO

This daily chart of GLD illustrates the BMJ ZLFilter 30 indicator with the HiLo channel displayed. This is similar to the BMJ FFilter 30 indicator with the HiLo channel that is illustrated in Example 2. You will note that this version, as a zero lag version, is more sharply responsive to changes in the underlying data series.
Also illustrated on this chart is the BMJ FFilter 30 PPO indicator. This version has the slower PPO and the difference histogram displayed on the chart as well. The color change bars together with the crossovers can give a visual clue to changes in trend.

5.5 Example 5

BMJ FFilter & SFilter with RSI & PPO

This daily chart of the QQQ illustrates the BMJ FFilter 30 indicator (yellow & red) and the BMJ SFilter 30 indicator (blue and magenta). These two indicators color bars, together with their crossovers, provide reasonable signals to changes in trend.

Also illustrated on this chart is the BMJ FFilter 30 RSI and the BMJ FFilter 30 PPO. These indicators can provide additional evidence of a change in trend. And when used in conjunction with the two Fractal Filter indicators can provide visual clues to take long and short positions.