INDICATORS

*For Your Digital Eyes Only*

# Filtering Price Movement

*Here is an alternative to the classic zigzag indicator, which may prove useful to visual technical analysts and chart pattern researchers.*

When there is need for algorithmic identification of price swings in a chart, there is a word that always comes to mind for technical analysts: *zigzag*. The zigzag indicator is based on the concept from Arthur Merill's 1977 book *Filtered Waves, Basic Theory: A Tool For Stock Market Analysis*. It filters price movements below a cutoff level, that is, a threshold. The threshold is either in point terms or in percentage terms. If you were, for example, using a threshold of *x* points, the zigzag would disregard all price movements less than *x* points. If, on the other hand, you used a threshold of *x* percent, the zigzag would disregard all price movements of magnitude less than *x* percent. When plotted, the zigzag is shown as a crooked line connecting peaks and troughs. The line segments of the zigzag are commonly referred to as its *legs*.

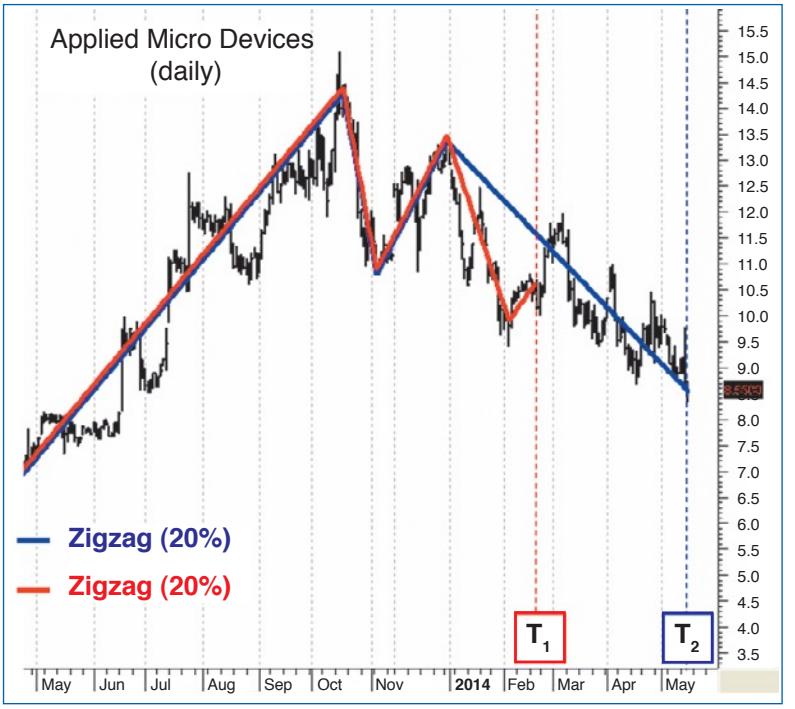


**FIGURE 1: THE DYNAMIC NATURE OF THE ZIGZAG'S LAST LEGS.** The red zigzag in this daily chart of Applied Micro Devices, Inc. (AMD) is based on a percentage threshold of 20% and it uses data up to date T1. The blue zigzag is based again on the 20% percentage threshold but it uses data up to date T2. In other words, the red zigzag is a snapshot from the history of the blue one. Notice how the last two legs of the red zigzag changed when price information from T1 and later were taken into account to create the blue zigzag. This chart was created in MetaStock, which plots the zigzag in a way such that its last two legs are dynamic. In other versions of zigzag, only the last legs are dynamic.

Notwithstanding that the zigzag identifies prominent peaks and troughs, it doesn't filter the price swings the same way a technician's eye would. In this article, I will introduce you to a more natural way of filtering the price, which is accomplished via what are called *perceptually important points*. This alternative to the classic zigzag indicator is closer to the way a human perceives the movement of price.

## LIMITATIONS OF THE ZIGZAG

The zigzag is accused of a serious drawback: Its last two legs (or, depending on the software, its last leg) are dynamic and usually change significantly as new data comes in. Consequently, the historical values of the zigzag are based on hindsight. So if you're using the zigzag in the same way that you use other classic technical indicators such as moving averages, relative strength index (RSI), stochastics, and so on, then zigzag won't be of much use. However, it can be useful if it's used to identify prominent price swings on a chart. Simply put, there is no way to know when the current price movement will pass the cutoff threshold before that happens (see Figure 1 for an example). In effect, the zigzag is a static tool that

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*by Giorgos E. Siligardos*

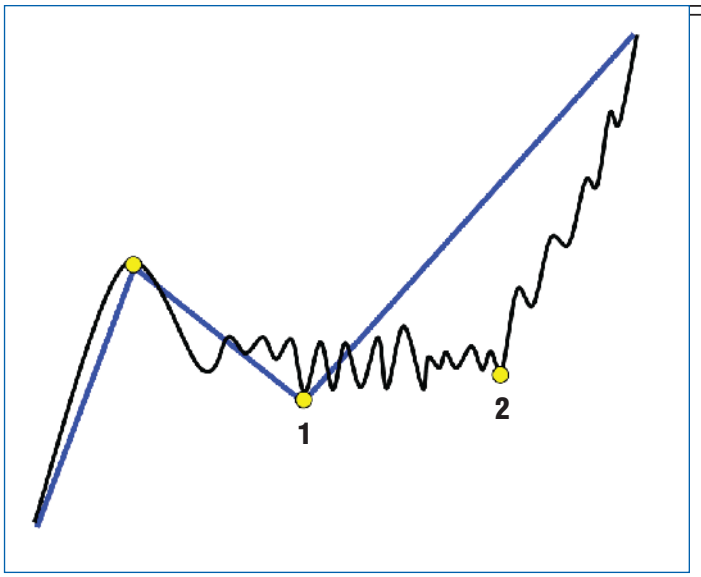



**FIGURE 2: NOT ALL POINTS IDENTIFIED BY THE ZIGZAG ARE VISUALLY PROMINENT.** The zigzag always tries to find and accent prominent price swings based on how high or low these swings go, but this makes it quite stiff. In this iconic example, the zigzag would disregard point 2 just because point 1 is a bit lower. From a visual perspective, however, point 2 was more important than point 1 since it was the pivot that sparked a swift and strong uptrend.

tries to mimic—often in a clumsy way—the eye of the analyst when it looks at a snapshot of a chart. It does so from a more mathematically rigid point of view, concentrating on the major swings of price (as defined by the cutoff threshold).

It must come as no surprise then that for the chart pattern analyst, the dynamic nature of the zigzag's last legs is not a drawback but a merit. For example, in his November 2003 STOCKS & COMMODITIES article "The Zigzag Trend Indicator," Spyros Raftopoulos introduced an interesting binary indicator that he called *zigzag trend*. The zigzag trend is essentially the zigzag without its dynamic feature, so its strong point is that it can be used and treated the same way as other common trend indicators such as the MACD, with the additional benefit of a low number of whipsaws. From a pattern analyst's standpoint, however, the absence of dynamic parts makes it completely incapable of identifying visually prominent peaks and troughs in a snapshot of a chart.

A more substantial drawback of the zigzag as a tool to represent a chartist's perception could be its dependence on the threshold parameter. In other words, you can't use the same cutoff threshold for all charts. A 20% threshold for long-term daily charts of stocks does a pretty good job most of the time, but it might be inefficient for short-term daily charts. So the analyst must first see the chart and then define the threshold that will give the zigzag the opportunity to identify the major swings. That initially negates the usefulness of the zigzag as a representative of the human eye when there is need for identification of major swings in thousands of charts. This is not a serious drawback, however, since there is a simple (albeit not perfect) workaround: You can take the range of values in a chart (highest value minus lowest value) and then define the threshold as a percentage of that range.

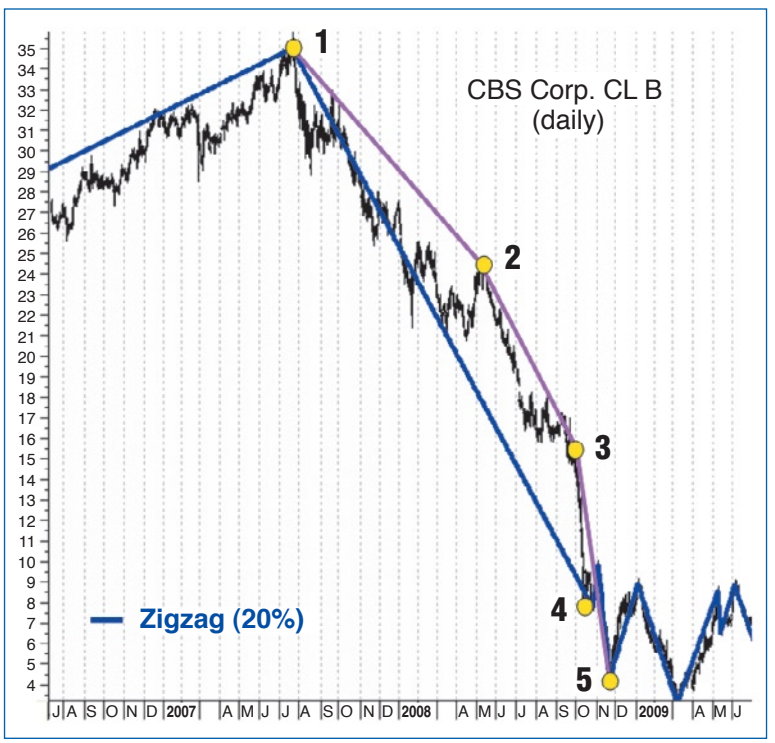



**FIGURE 3: THE ZIGZAG ALWAYS CONNECTS PEAKS WITH TROUGHS.** The zigzag has a unilateral way to filter price movements. It always connects peaks with troughs. This means that it is blind regarding changes in the strength of directional movements and so misses important information with respect to the visual perspective of a price trend. In this daily chart of CBS Corp., the 20% threshold zigzag (in blue color) is unable to see the visual importance of points 2 and 3 although they clearly mark changes in the severity of the downtrend. It considered point 4 as significant, but that is not visually prominent. The pink crooked line gives a much better sight of the price movement from point 1 to point 5.

So what are the essential limitations of the zigzag from a chartist's point of view? One limitation is that it focuses exclusively on prominent price swings (peak to trough and trough to peak). More precisely, although it indeed identifies meaningful pivots in price, it often misses other pivots that are even more important regarding their role in the visual comprehension of the movement of the price (Figure 2). Also, its bias toward only price swings makes it incapable of perceiving special cases where connection of peaks to peaks or troughs to troughs describes the price behavior in a better way (see Figure 3). Another important limitation of the zigzag has to do with the way it summarizes and ranks information on a chart. More precisely, you can't force the zigzag to summarize the price action into a specific number of swings. For example, you can't tell the zigzag to filter the price action and condense it into, say, four swings (legs). You will know the total number of the zigzag's legs only after it has filtered the price.

## MEET THE PIPS METHOD

An alternative method of filtering price fluctuations is one that is based on the idea of *perceptually important points*, or PIPs. While roots of this method trace back to 1973, it was mainly introduced in 2001 by F.L. Chung *et al*. in their academic research paper "Flexible Time Series Pattern Matching Based On Perceptually Important Points." The PIPs method makes it feasible to construct a modified version of the classic zigzag indicator that will

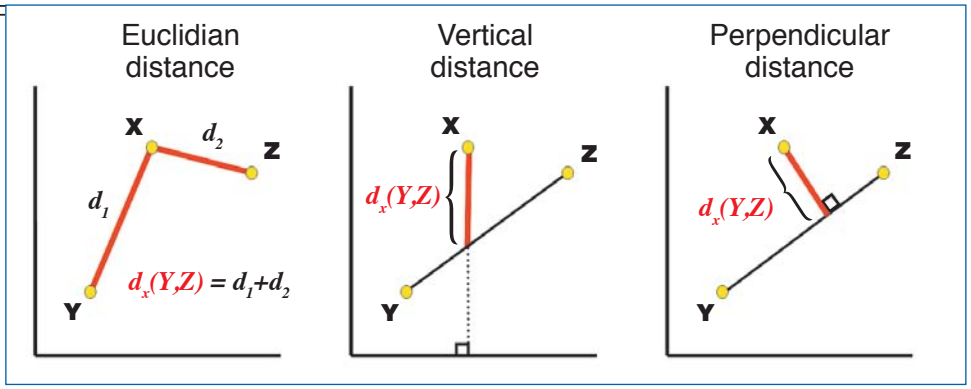



**FIGURE 4: THE THREE FLAVORS OF DISTANCE OF ONE POINT FROM A PAIR OF TWO POINTS.** Three ways to define the distance of a point X from a pair of points Y, Z have been proposed in the literature: The Euclidian, the vertical, and the perpendicular.

overcome the limitations I mentioned earlier because its filtering process is much closer to the way a technician's eye scans a chart. This doesn't mean that this new method should wholly replace the classic zigzag. It is just a different method serving a different purpose. The PIPs method is more appropriate for representing price movement from a visual standpoint. In brief, while the zigzag starts from the left of a chart and creates legs as it moves to the right, the PIPs method identifies important points based on a holistic approach: All price data is indirectly taken into account for the identification of each and every leg.

## THE CONCEPT OF DISTANCE

Before diving into the details of PIPs, it is necessary to define the concept of the distance of one point with respect to two other points. Let X, Y, and Z be three points in a time–price chart in this order: Y, then X, then Z. In their 2008 paper "Representing Financial Time Series Based On Data Point Importance," Tak-chung Fu *et al*. proposed three ways to define the concept of distance $d_X(Y,Z)$ of X from points Y and Z:

- ***Euclidian distance:*** $d_X(Y,Z)$ is defined as the distance of X from Y plus the distance of X from Z.
- ***Vertical distance:*** If ε is the straight line connecting the points Y and Z, then $d_X(Y,Z)$ is defined as the vertical distance of X from ε.
- ***Perpendicular distance:*** If ε is again the straight line that connects the points Y and Z, then $d_X(Y,Z)$ is defined as the perpendicular distance of X from ε.

In Figure 4 you can see pictorial examples for these three flavors of distance.

## IDENTIFYING THE PIPS

Consider a set of points in a time–price chart that are derived by the values of an indicator such as the MACD or the closing price of a stock. A point from this set will be considered *perceptually important* when it dominates all other points in terms of importance in the perception of the visual shape that these points create.

That's a loose definition, I know, so let me define the PIPs via a formal inductive procedure using the vertical kind of distance (refer to Figure 5 for a visual aid).

***Step 1:*** The first two PIPs are the first and last points in the chart. Name them A and B, respectively. I call these PIPs *marginal* for obvious reasons. All the other PIPs will be called *internal*.

***Step 2:*** To find the third PIP, calculate the vertical distances of all points of the set from the couple A, B (that is, calculate all $d_X(A,B)$ where X runs all points of the set). The point X, which produces the maximum distance, is the third PIP. Let

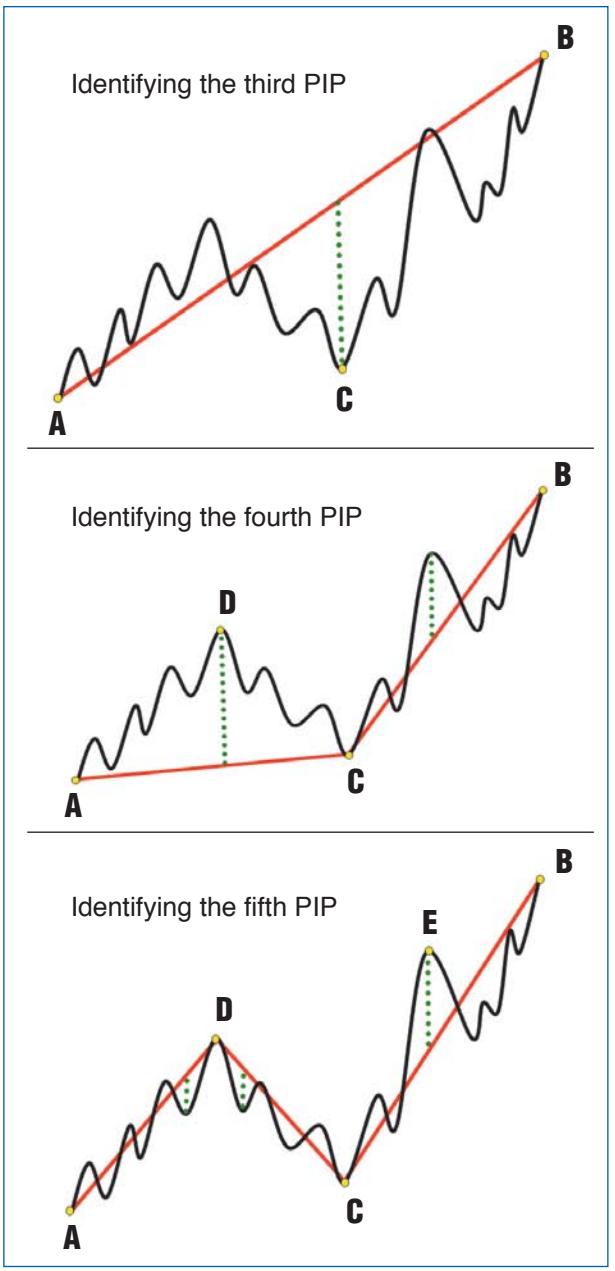



**FIGURE 5: IDENTIFYING PERCEPTUALLY IMPORTANT POINTS (PIPS) USING THE VERTICAL DISTANCE.** The first two PIPs are the first and last points (A and B). From there on, to designate a point as perceptually important, you go through a procedure that takes into account all price data in the chart. More precisely, you go through calculations of vertical distances involving all data in the chart and lines connecting previously identified PIPs.

this point be C. There are now three PIPs that appear in this time order in the chart: ACB.

***Step 3:*** Using the same previous idea, run through all set points between A and C and calculate their vertical distances from the couple A, C. Also run through all set points between C and B and calculate their vertical distances from the couple C, B. The maximum distance found from these two runs marks point D, which is the fourth PIP.

***Step 4:*** Say that D is between A and C. For the fifth PIP you make three runs of vertical distance calculations: one from A to D, one from D to C, and one from C to B. The maximum distance found marks the fifth PIP (E in Figure 5).

***Next steps:*** You can repeat this procedure to find as many PIPs as you like (a new PIP for every step). The procedure stops when you have identified your desired number of PIPs or when the maximum distance in a step is zero (as this would mean that no additional information is gained by identifying new PIPs). Of course, there is always a natural limit to the number of PIPs you can identify—and that limit is the total number of points in the chart.

As you probably noticed, the inductive procedure used to identify the PIPs has an additional benefit: The PIPs are automatically ranked in descending order of perceptual importance. The mathematically inclined, however, might have already found a possible problem with this procedure: What if there is not one and only one maximum distance among the vertical distances you calculate for a step? This is rare but it can happen. In this occasion, there will be more than one finalist for the next PIP designation, so you either designate all of them as PIPs or, when you need to select only one of them because you want only one PIP, you need a selection convention regarding which one to designate as the next PIP.

As a simple solution for the second case, I opt for the finalist, which lies in the right-most side of the chart. In other words, I focus on the most recent data. You could use other methods of selection, but I believe this is the simplest and most efficient for our purpose.

A similar procedure could be used to identify PIPs using Euclidian or perpendicular distance. But what is the most appropriate distance to use? A study of various examples shows that from a visual point of view, the Euclidian distance identifies terrible PIPs. Further, the vertical and perpendicular distances produce exactly the same PIPs in most of the real cases. In effect, you can use only the vertical distance and disregard the other two. The indicator I will present uses the vertical distance and the selection convention discussed earlier.

## THE ZZTOP INDICATOR

Now that you know how to calculate PIPs in an indicator's plot, you can connect them using straight line segments to create *legs* and, *voilà*—you have a new zigzag-like indicator. (Note that the number of legs equals the number of PIPs minus one.) I call this indicator *zzTOP*. The "zz" part of the name comes from it being a generalized kind of zigzag and—what can I say—the "TOP" part comes because I am listening to ZZ Top's hit song "Legs" as I write this article.

The zzTOP indicator requires three arguments (parameters). These are: *indicator*, *LegsNo,* and *scale*. Let's look at them in detail.

***Indicator***

Unlike the classic zigzag, the zzTOP doesn't rely on cutoff thresholds, so it can be directly applied successfully to any kind of indicator. The indicator parameter is therefore the indicator upon which you want the zzTOP to be applied. It can be the closing price line, the MACD, the RSI, or any indicator you can think of.

***LegsNo***

This is a numeric parameter (a positive integer greater than or equal to 1) that defines the total number of legs you want the zzTOP indicator to have. The number of PIPs equals this number plus 1. For example, a value of 20 for this parameter indicates that you want the zzTOP to have exactly 20 legs (or equivalently, you are interested in 21 PIPs).

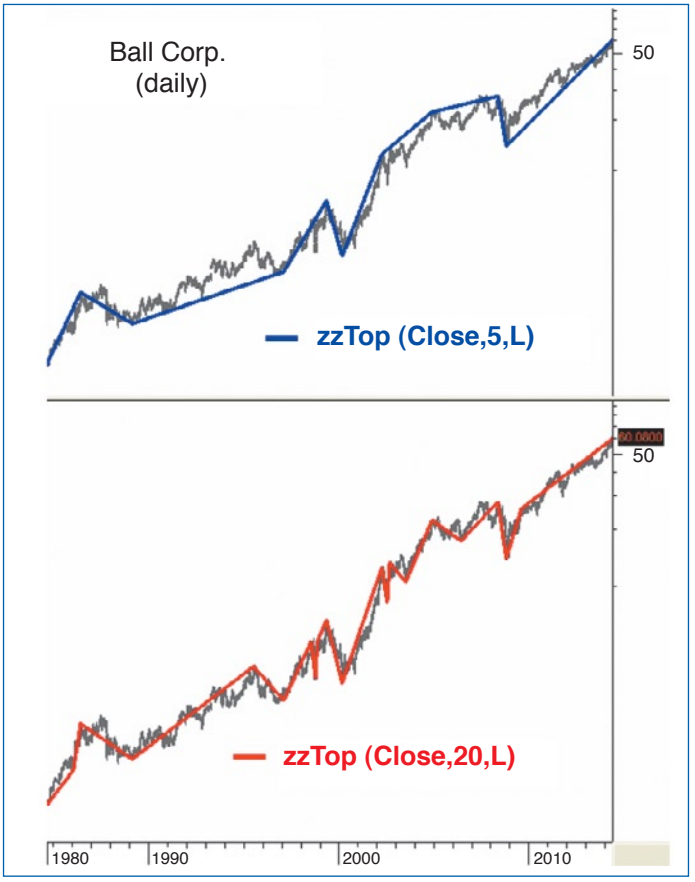



**FIGURE 6: ZZTOP PERFORMANCE IN THE DAILY CHART OF BALL CORP. (BLL).** The zzTOP indicator is a nice way to approximate the price action via a predefined number of linear legs. The more legs that are used, the closer the approximation.

***Scale***

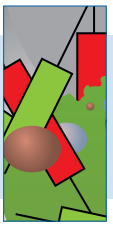
This parameter refers to the scaling of the *y*-axis of the chart, and it has a significant effect on the performance of the zzTOP. The scale parameter can take two values: "A" (arithmetic) and "L" (logarithmic). If you want the zzTOP to filter the movements of the indicator parameter as seen in an arithmetic scale, then you set this parameter to "A." This instructs the zzTOP indicator to apply its PIPs identification algorithm to the indicator itself. If, however, the indicator is positive and you want the zzTOP to filter its movements as seen in a semilogarithmic scale (in such a scale, the *y*-axis is logarithmically scaled, whereas the *x* axis is arithmetically scaled), then you set this parameter to "L." This latter case is equivalent to first taking the natural logarithm of the indicator, then applying the zzTOP with a scale parameter of "A," and then applying the exp() function in the result.

As an example, zzTOP(close, 30, L) refers to the zzTOP indicator applied on the semilogarithmic chart of the closing price of a security demanding that the zzTOP must have exactly 30 legs. Similarly, zzTOP(MACD, 20,A) refers to the zzTOP applied on an arithmetic chart of MACD and demanding that the zzTOP must have exactly 20 legs.

It is important to note again that while the zigzag scans the price series from left to right using a number (the threshold) to classify a price swing as important, the zzTOP uses information from all loaded data in a chart every time it identifies a new internal PIP. This is invaluable from the point of visual comprehension of a chart, but it comes at a price: The zzTOP is much more prone to changing many of its legs when new price data is added to the chart.

## CHART EXAMPLES

It is now time to go through some chart examples. In Figure 6 you can see how the zzTOP(close,5,L) and zzTOP(close,20,L) perform in the same chart. The former scans all prices shown in the chart, finds six PIPS, and summarizes the price action into only five legs. The latter finds 15 more PIPs and summarizes the price action into 20 legs. Note that the zzTOP doesn't have to connect only peaks with troughs. It can also connect peaks to peaks or troughs to troughs and thus it is more flexible in summarizing and expressing the price movement quirks. In this regard, the choice of "zz" in the name zzTOP is perfectly suited because the zzTOP is not limited to only zigzags—it can do *zigzigs* and *zagzags* too.



**For the chart pattern analyst, the dynamic nature of the zigzag's last legs is not a drawback but a merit.**

In Figure 7 you can see how the zzTOP(close,20,L) differs from the classic zigzag indicator with a percentage threshold of 20%. Note especially the period from the end of 1999 until the end of 2001. The zzTOP clearly depicts the price movement in a better way than the zigzag does in terms of visual clarity, using just a few legs.

Figure 8 shows how the zzTOP may change when you put new data in a chart. Period 2 starts at the beginning of 1983 and ends at the beginning of 2000, whereas period 1 starts at the beginning of 1983 and ends near the summer of 2009. The zzTOP indicator in blue is applied in period 2 only (that is, it doesn't look outside period 2) and identifies 20 legs for that period. The zzTOP indicator in red is applied in period 1 and summarizes the price action into 20 legs for the entire period. Both zzTOPs have the same parameters except for the time period upon which they are applied. It is obvious that new data can have a significant effect on the performance of zzTOP not only because of the restriction in the number of legs it is allowed to present but also because its algorithm identifies all internal PIPs, starting from the marginal ones (the first and last prices in the chart). In effect, all internal PIPs—and consequently all legs—are affected by the first and last prices in the chart.

In Figure 9 you can see why the scale parameter is important. In the top chart you see the weekly price of Caterpillar Inc. (CAT) with the 20-leg zzTOP based on the closing price using *arithmetic* as its scale parameter. In the lower chart you see the same weekly chart of CAT with the same 20-leg zzTOP indicator, but this time, the scale parameter is *logarithmic*. The upper chart is arithmetic, whereas the lower one is semilogarithmic. It is clear that the scale parameter is there to ensure that the zzTOP "sees" the chart the same way a chartist would do with his eyes. In the upper chart (the arithmetic one), the price movement before the year 2000 is seen as almost horizontal by the human eye. That's because after 2000, the prices advanced significantly. In effect, the swings of the price after 2000 overshadow those before 2000 from an arithmetic perspective and the arithmetic-scale zzTOP correctly focuses on the price swings after 2000 because that's what a human eye would naturally do.

In the lower chart, though, the semilogarithmic scale makes it possible to see things from a percentage perspective, so the price swings before 2000 are visually more prominent now. The logarithmic-scale zzTOP in the lower chart correctly identifies the 20 most noticeable price swings the same way a human eye would.

Most chartists use semilogarithmic charts to plot the prices of trading instruments, so an arithmetic-scale zzTOP is practically useless when applied to the price charts (especially the long-term ones). The charts of common technical indicators (such as stochastics, MACD, and RSI) are nonetheless always arithmetic, so the ability of zzTOP to adapt to scale differences can be useful. In Figure 10 you can see how the arithmetic-scale zzTOP performs in a weekly chart of Archer Daniels Midland Co. (ADM).

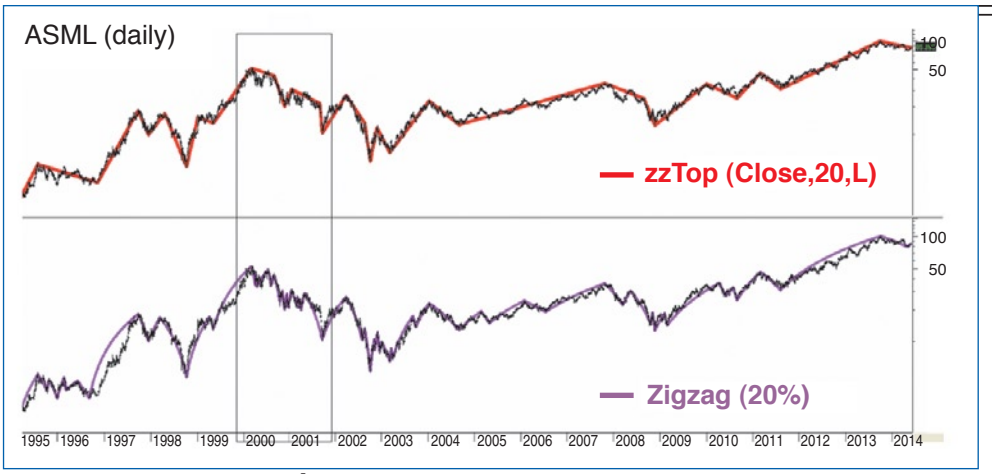



**FIGURE 7: ZZTOP AND ZIGZAG VIS À VIS.** The upper and lower daily charts of ASML Holding (ASML) are the same. The zzTOP(close,20,L) indicator is overlaid in the upper chart, whereas in the lower chart, the zigzag identifies peaks & troughs based on a percentage threshold of 20%. From a visual standpoint, the zzTOP indicator can effectively render the essentials of the price movement using much fewer legs than the zigzag (see its performance between late 1999 and late 2001). This is mainly because of two reasons: First, it is allowed to connect peaks to peaks and troughs to troughs, and second, it takes into account all price data for the calculation of each leg. The zigzag on the other hand doesn't look at all price data every time it creates a leg. It processes the data strictly from left to right and it can only change its last two legs during the identification procedure.

## AUTOMATION

The zzTOP requires you to state how many legs you are interested in. The opportunity to *a priori* define the number of legs gives you tremendous freedom, but sometimes you may want the indicator to choose how many legs to identify based on a *goodness of fit* level that you desire. In other words, you might be interested in a hybrid between the zzTOP and the zigzag. This can be accomplished by requiring the zzTOP indicator to keep finding PIPs and to create legs up to a predefined proximity level (an equivalent to the threshold of the zigzag). I named this automated version of zzTOP the *zzTOPauto*.

The zzTOPauto indicator has the same indicator and scale parameters as the zzTOP does, but instead of *LegsNo*, it has a proximity parameter. So zzTOPauto(close,10,L), for example, refers to the zzTOPauto applied to the closing price of a security on a semilogarithmic chart with a proximity of 10. Proximity is a positive number up to 100 and represents a percentage of the range of values of the indicator parameter. Its purpose is to give the zzTOPauto a level of goodness of fit you are interested in. Note that the lower the proximity, the closer the zzTOPauto line must be to the indicator plot and thus the more legs will be needed.

Consider, for example:

zzTOPauto(indicator,20,A)

and say that the highest value of the indicator is 200 and its lowest value is 40. The range of the indicator is therefore R=200-40=160. Since the proximity parameter is 20, you are interested in the required number of legs such that the vertical distances between the values of the indicator and the legs are less than 20% of 160 (which equals 32). In other words, a proximity of 20 means that you want the zzTOPauto to keep finding PIPs and to keep creating legs up to the point where the indicator's values will not divert more than 20% of *R* from the zzTOPauto's plot. Of course, for logarithmic-scale zzTOPauto, the range of the indicator must be measured in a way that will take into account the visual idiosyncrasy of the semilogarithmic charts. More precisely, for the logarithmic-scale zzTOPauto, the range of the indicator is measured using the logarithms of the indicator values instead of the values themselves. In Figure 11 you can see how the zzTOPauto (close,10,L) did a great job in outlining the price movements of Boston Scientific Inc. (BSX). Using a higher proximity parameter would result in fewer legs for the zzTOPauto, whereas a lower proximity parameter would result in more legs.

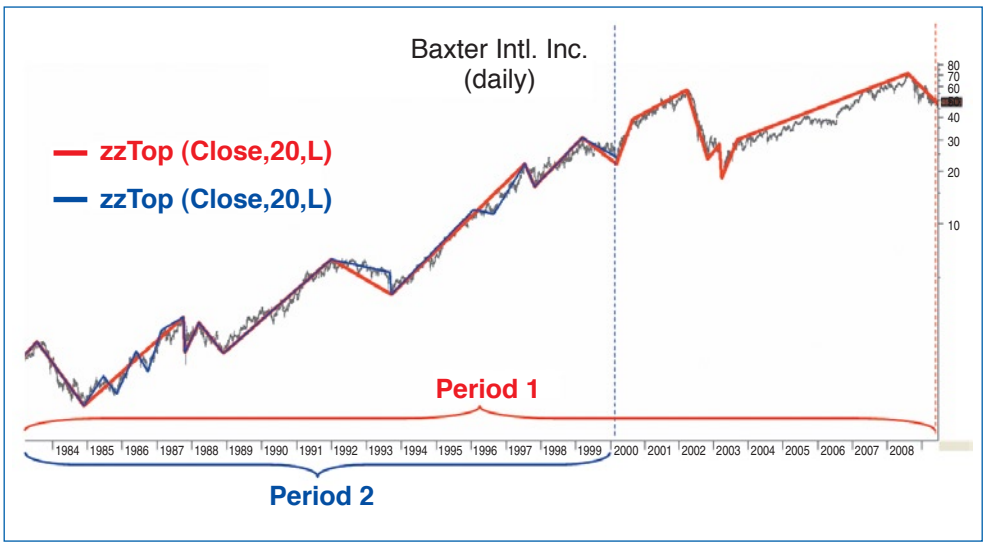



**FIGURE 8: ZZTOP USUALLY CHANGES DRAMATICALLY WHEN NEW DATA IS ADDED.** That zzTOP identifies an internal PIP taking into account all previously identified PIPs, and that the first and last prices in the chart are always the first two PIPs means that all internal PIPs (and consequently all legs) are indirectly affected by the first and last prices of the chart. So as new data is added to a chart, all the legs of the zzTOP face the danger of change. As more and more data is added, all of its legs will finally change, since the number of legs is constant. This feature of the zzTOP is clearly seen in the daily chart of Baxter International Inc. (BAX), where the zzTOP(close,20,L) is applied to price data for two periods. The red zzTOP is applied to price data for period 1 and the blue zzTOP is applied to price data for period 2.

## CODING AND USAGE

The correct way to perform backtesting is to recalculate the values of all indicators involved whenever a new bar is taken into account. But that would require too many calculations. To decrease the time needed to perform the backtesting, the typical technical analysis software loads all historical data, then calculates the

values of indicators, and then uses these calculated values to simulate the backtesting. This is fine for common indicators such as MACD and RSI, but for dynamic indicators like zigzag, zzTOP, and zzTOPauto (which change their historical values when new data comes in), this approach produces erroneously prettifying results. As a consequence, the zzTOP and zzTOPauto indicators *must not* be used for backtesting in the typical software program using the software's built-in backtesting feature. You can, however, use these indicators in a static fashion as a digital substitution for your eyes when you want your software to scan thousands of charts.

Coding the zzTOP and zzTOPauto indicators requires some time and effort. For software whose formula language lacks looping capabilities (like MetaStock, for example), the zzTOP and zzTOPauto must be coded using a versatile programming language, embedded inside a dynamic link library (DLL) file, and then be called by the software as external functions from the DLL. To plot the zzTOP and zzTOPauto indicators in MetaStock, I created a DLL (named "zzTOPindicators.dll") that's available for download from the Article Code area of www.traders.com, or from http://traders.com/files/zzTOPindicators.zip directly. In the sidebar "ZZTOP And ZZTOPauto Indicators In Metastock," you can find information on how to download and use it.

## ROCK & ROLL

The zigzag's way of filtering fluctuations, although simple, is not always appropriate for capturing the visual representation of price behavior. The zzTOP and zzTOPauto indicators presented in this article offer an alternative way to transfer your visual perception to your software. Perhaps, if you go through thousands of charts, chances are you will encounter cases where the zzTOPs will miss a few points that your eye would consider as visually important; however, that

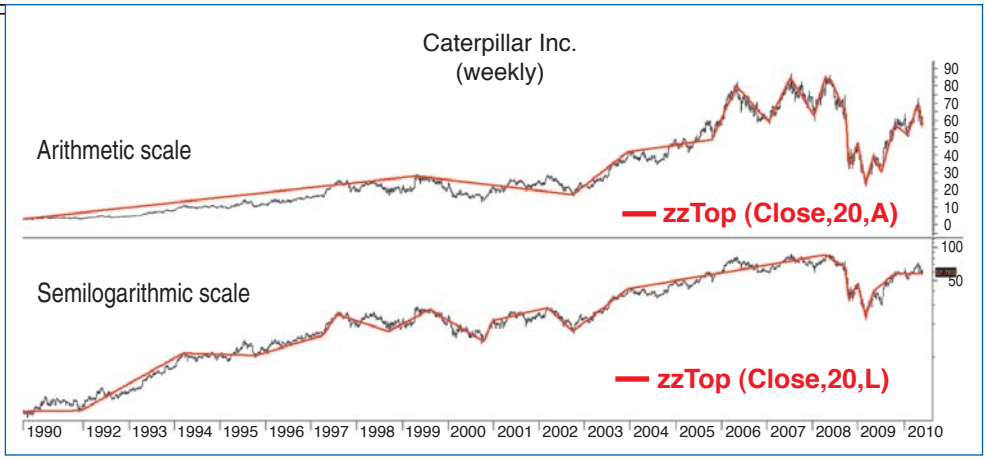



**FIGURE 9: ARITHMETIC VS. LOGARITHMIC SCALE.** The scale parameter of the zzTOP determines the way the zzTOP "sees" the price. The "A" (arithmetic) scale parameter instructs the zzTOP to see the price from an arithmetically scaled y-axis whereas the "L" (logarithmic) scale parameter instructs it to see the price from a logarithmically scaled y-axis. The results can be strikingly different for these two cases as it is seen in this weekly chart of Caterpillar Inc. (CAT).

**The zzTOP doesn't rely on cutoff thresholds so it can be directly applied successfully to any kind of indicator.**

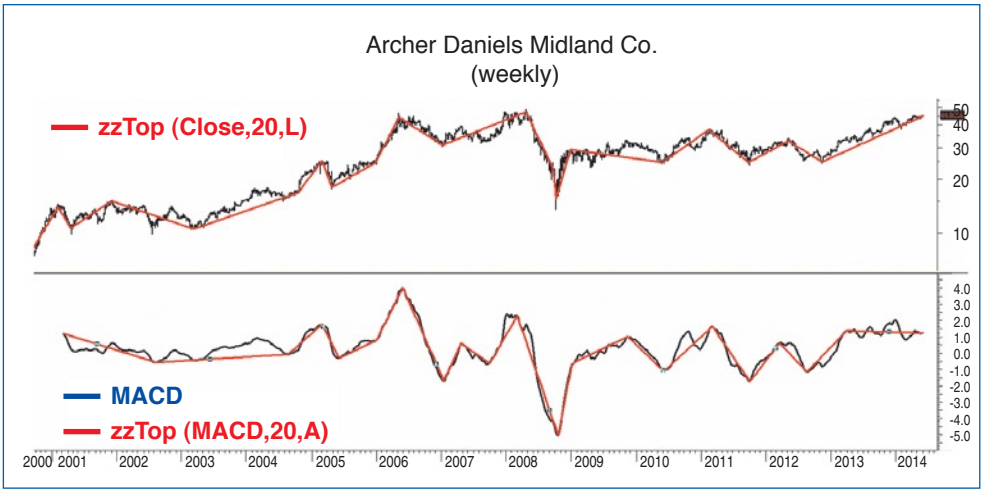



**FIGURE 10: IDENTIFYING THE SWINGS OF MACD IN A WEEKLY CHART OF ARCHER DANIELS MIDLAND CO. (ADM).** The zzTOP indicator performs pretty well when applied in indicators without the need to define filtering thresholds.

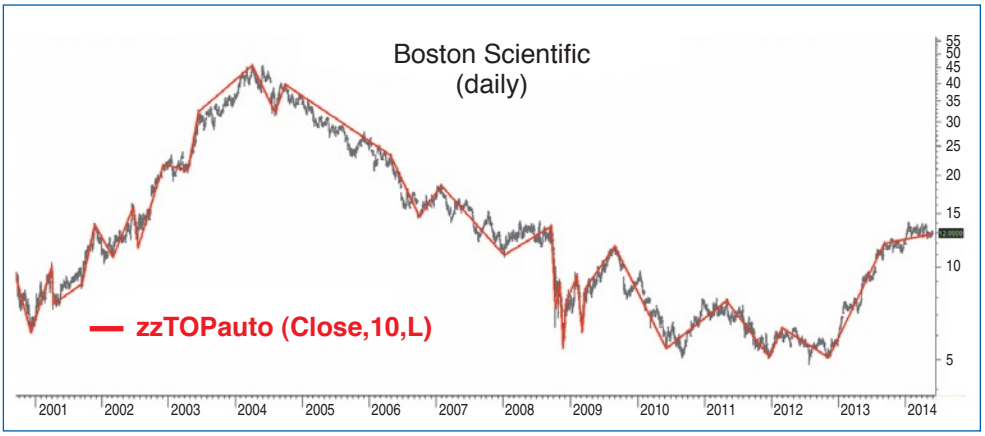



**FIGURE 11: PERFORMANCE OF ZZTOPAUTO WITH A PROXIMITY PARAMETER OF 10 IN A DAILY CHART OF BOSTON SCIENTIFIC INC. (BSX).** The zzTOPauto indicator in this chart did a great job in outlining the price movements of BSX. Using a higher proximity parameter would result in fewer legs for the zzTOPauto, whereas a lower proximity parameter would result in more legs.

would generally be rare. So if you are not pleased with the way the zigzag indicator perceives the price movements in a chart, then get ready to rock and let the zzTOPs do their magic.

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*The DLL file mentioned in this article is available from http://traders.com/files/zzTOPindicators.zip as a downloadable zip archive as well as from the **Subscriber Area** at our website, www.Traders.com, in the **Article Code** area.*

*See our **Traders' Tips** section beginning on page 50 for commentary on implementation of Siligardos' technique in various technical analysis programs. Accompanying program code can be found in the Traders' Tips area at Traders.com.*

## FURTHER READING

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‡MetaStock
*†See Traders' Glossary for definition*
*‡See Editorial Resource Index*



## ZZTOP AND ZZTOPAUTO INDICATORS IN METASTOCK

Readers can download my "zzTOPindicators.dll" file as a .zip archive from http://traders.com/files/zzTOPindicators.zip or from the **Article Code** of the *Technical Analysis of* STOCKS & COMMODITIES website, **www.traders.com**. After downloading, you will need to expand the .zip file and place a copy of it in MetaStock's external function DLLs folder (usually located at C:\Program Files\Equis\MetaStock\External Function DLLs).

The zzTOP and zzTOPauto indicators can be called by the following code:

```
ExtFml( "zzTOPindicators.zzTOP",Indicator ,LegsNo ,Scale)
```

and

```
ExtFml("zzTOPindicators.zzTOPauto",Indicator,Proximity,Scale)
```

respectively. For example, the code:

```
ExtFml( "zzTOPindicators.zzTOPauto",CLOSE ,15 ,L )
```

calls the zzTOPauto indicator for the close price in a semilogarithmic scale with a proximity of 15.

*—G. Siligardos*