MESA

1. INTRODUCTION

MESA is a program that gives accurate trading signals based on the measurement of short term cycles in the market. Cycles exist on every scale from the atomic to the galactic. Therefore, we have every reason to believe cycles exist in the market.

It has been said that the market is characterized by the famous random walk problem. Based on this, proponents assert the market is basically efficient. This is clearly wrong because there have been a number of consistently successful traders. However, looking deeper, we see that the market is analogous to a constrained random walk. That is because time can only move forward and prices can only move up and down. The constrained random walk is called the "drunkard's walk" because it describes the staggering as the "drunk" moves from point A to point B. There are two solutions to the drunkard's walk problem. In the first case, the "drunk" flips a fair coin to determine whether he steps to the right or left as he steps forward. The random variable is direction. The solution to this formulation of the problem is a rather famous partial differential equation called the Diffusion equation. It describes natural phenomena, such as heat flowing up the stem of a silver spoon when it is placed in a hot cup of coffee or smoke flowing from a smokestack. In the second case, the "drunk" asks himself whether he should take the next step in the same direction as the last one or whether he should reverse his direction depending on the outcome of the coinflip. In this case, the random variable is momentum and the solution is another rather famous partial differential equation called the Telegraphers equation. Among other things, the Telegraphers equation describes waves on a telegraph wire or the meandering of any river in the world.

Thus, the Drunkards Walk describes the two market modes. The Trend Mode is similar to smoke from a smokestack, having a general direction and a fine grain randomness. The Cycle Mode is analogous to the meandering of a river. As surely as water flows downstream, time moves forward. You can almost imagine being on a raft in the river. Once you enter a given meander you can accurately project where that meander will take your raft. And so it is with cycles in the market. Cycles can be accurately measured scientifically. Knowing the cycle content, that content can be subtracted from the composite to produce the trend.

Market cycles can be measured several ways. Perhaps the simplest is to count the number of bars between successive lowest lows or highest highs. The resulting bar count is the cycle period. Cycle periods can also be measured using a frequency discriminator after taking a Hilbert Transform of the data. Fast Fourier Transforms (FFT) are often (and inappropriately) used. FFTs are inappropriate for the measurement of market cycles because the constraints and resulting resolution are overlooked. The Maximum Entropy Spectral Analysis

(MESA) approach was first developed in the 1960's to process seismic information for oil exploration. MESA can make a high resolution measurement of a market cycle using less than one cycle's worth of data. Using a small amount of data is critical because it increases the probability of the data being stationary during the measurement period. Stationary data is crucial for accurate measurements. Put another way, you need to know that you are in a river meander to know where that meander is going to take your raft.

MESA offers five indicators to assist your trading. These are:

1) Measurement of the dominant cycle. This lets you know the distance between successive peaks or valleys. If you have just passed a peak, then it is reasonable to expect the next valley to be about a half cycle into the future. The dominant cycle (or a fraction of it) can be used to dynamically adjust other indicators. For example, Stochastics and RSIs work their best when a half cycle is used to peak their performance.
2) Measurement of the cycle phase. A constant rate change of phase is a basic definition of a cycle. If the phase is changing at the rate of 36 degrees per day, then you cover 360 degrees in 10 days. Therefore, you have a 10 day cycle. Departure from a constant rate change of phase is a sensitive way to detect the end of a cycle mode.
3) Sine and LeadSine Oscillator. The Sine Indicator is just plotting the sine of the measured dominant cycle phase. The LeadSine Indicator is a plot where the phase is simply advanced 45 degrees. The crossing of the Sine and LeadSine Indicators are buy and sell points because they anticipate the turning points when the market is in a cycle mode. There are two advantages of the Sine and LeadSine Oscillator. Firstly, the line crossing anticipates the cyclic turning points. This enables timely entry and exits of market positions. Secondly, the phase tends not to advance when the market is in a Trend Mode. This causes the Sine and LeadSine to wander in a somewhat parallel fashion. The lack of line crossings in the Trend Mode is an advantage over the false whipsaw signals generated by most oscillators.
4) Instantaneous Trendline and Kalman Filter. The Instantaneous Trendline is created by filtering out the dominant cycle, leaving the residual as the trend. This procedure produces a trendline that looks like a moving average, and whose advantage is that it has a minimum lag. The Kalman Filter line is a data smoother that has nearly zero lag. When the market is in a cycle mode, the Kalman Filter line will criss-cross the Instantaneous Trendline every half cycle. Therefore, if the Kalman Filter line fails to cross the Instantaneous Trendline within a half dominant cycle you can declare the Trend Mode to be in force. The Trend Mode ends when the Kalman Filter line next crosses the Instantaneous Trendline.
5) Cycle Mode. This is a convenience indicator, displaying the conditions described by the Instantaneous Trendline and the Kalman Filter line. The market is in a Trend Mode when the value of this indicator is 1 (one) and is in a Cycle Mode when the value is 0 (zero).

2. THEORETICAL WAVEFORMS

MESA is as easy to use as any of the standard indicators. As opposed to fixed rule indicators, all MESA indicators dynamically adjust to current market conditions.

It is incumbent for any cycle-measuring program to prove that complex cycles are actually being accurately measured. In addition, you should become aware of the theoretical capabilities and limitations of your market analysis tools. This section addresses these two goals.

The Sinewave example of Figure 1 is a trivial measurement. The 24 bar cycle length can be determined simply by measuring the distance between successive lows or successive highs. The factors that make cycle analysis difficult are noise mixed with the cycle, shifts in the cycle over a period, combinations of several simultaneous cycles, and combinations of these effects. We prove that ***MESA*** handles these cases using deterministic theoretical waveforms. We also challenge any other trading program to make comparable analyses.

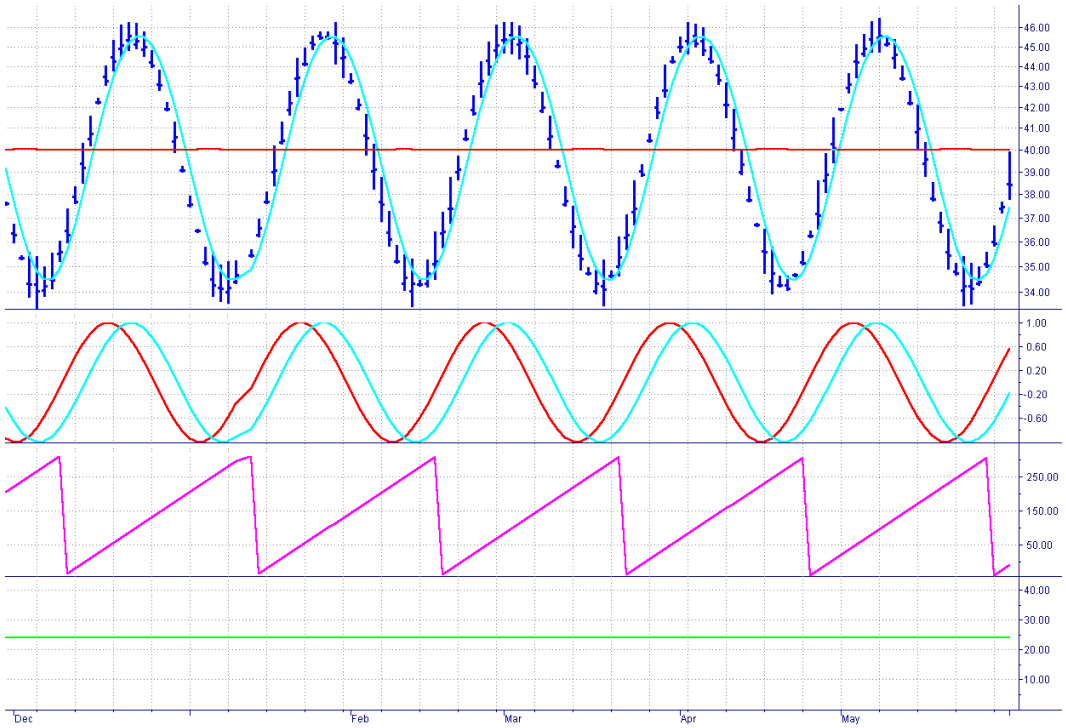

Figure 1: Theoretical Sinewave Graphics Screen

Figure 1 has four major segments. These are the price bars, the Sinewave Indicator, the phase of the measured dominant cycle, and the dominant cycle segment. The Mode is not displayed because the market is obviously only in the Cycle Mode for this theoretical example.

1) Price Bar Segment

The blue price bars extend from the high of the day to the low of the day. The opening price is indicated as a tick on the left side of the bar and the closing price is indicated as a tick on the right side of the bar. The scale for the prices is at the right of the display. The Instantaneous Trendline (the straight red line), the Kalman filter (the cyan line closely following the price midpoints) are used to indicate a Trend Mode. When in the Cycle Mode, the Kalman filter line crosses the Instantaneous Trendline every half cycle. Failure to make this crossing denotes the onset of a trend. The trend is over when these two lines again cross.

2) Sinewave Indicator Segment

The Sinewave Indicator is formed as the sine of the measured phase of the dominant cycle. The leading curve uses the phase advanced by 45 degrees (1/8th of a cycle), while the lagging curve uses the unaltered phase. As a result, the curves cross prior to every cycle turn, and provide an advance indication. The indicator curves should look similar to sinewaves at the time of the signal, one indication the market is in a cycle mode. When the market is in a trend mode the curves will wander around erratically, and will tend to run parallel. Trades entered on the basis of the indicator crossings should be exited immediately when a trend mode is identified if the trend is in the opposite direction of your cycle mode trade.

3) Measured Phase Segment

The third display segment displays phase of the measured dominant cycle. One definition of a cycle is a phenomena that has a constant rate change of phase. For example, a cycle completes 360 degrees, or one full rotation, every cycle. Therefore a perfect 10 day cycle would have a rate change of 36 degrees per day. If the cycle is not perfect then the rate change of phase will not be constant. This is a particularly sensitive way to detect whether the market is in a cycle mode or a trend mode. Failure of the phase to increase linearly is a sensitive indication that a cycle mode can be failing.

4) Dominant Cycle Segment

The bottom display segment shows the ebb and flow of the cycles in the market by displaying the measured dominant cycle length in synchronism with the price bars. In this segment the length of the cycle is indicated by the vertical scale of the segment. The fact that the indicated dominant cycle length is 24 bars shows the theoretical cycle has been accurately measured.

Variations of the cycle frequency pose real problems for spectral estimators. The difficulty arises from the data not being stationary over the observation period. In statistical communication theory, stationary data means that the probability

distribution of the data is independent of the selection of the time origin. In our case, this means the cycle is not stable and consistent over the observation period. The shorter ***MESA*** observation period achieves a nearly stable cycle condition with a higher probability than with other spectral estimators, such as Fast Fourier Transforms.

We next examine the effect of nonstationarity on the ***MESA*** displays. Figure 2 shows a theoretical sinewave whose period is continuously increasing at a slow rate. The very important point is that the continuously varying period of the cycle is accurately measured by ***MESA*** on a bar-by-bar basis. There is no course appraisal similar to estimating the period by counting the bars between successive lowest lows. The ***MESA*** measurement is continuous.

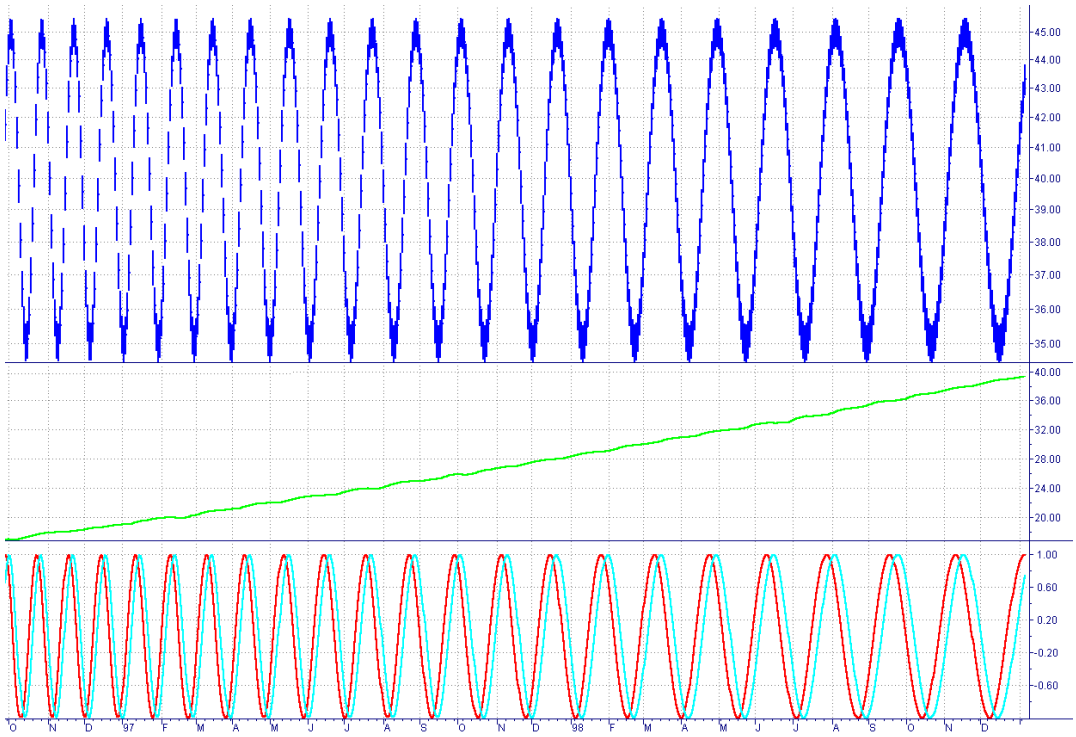

Figure 2. CHIRP Display

Figure 2 shows that ***MESA*** accurately measures the cycle periods over the range from 8 bar cycles to 40 bar cycles. In addition, Figure 2 demonstrates that the Sine and LeadSine signals have a constant amplitude and consistent phase relationship over the entire range of the Chirp cycle periods. This means their crossings give accurate Cycle Mode turning point signals over the full range of cycles that are likely to be encountered.

We have vigorously exercised the measurement capabilities of ***MESA***. As a result, you have gained some insights into the strengths and limitations of the program. Recognizing these, you will know best how to apply the displays to

your trading. You can also compare the analysis capabilities of ***MESA*** to any other cycles program on a deterministic basis. The theoretical waveforms free you from relying on anecdotal evidence. You should never forget that if analysis becomes too complex or confusing it is perfectly acceptable to stand aside until the confusing issues are resolved. Now that we understand what ***MESA*** can and cannot do theoretically, we will look at some real-world examples for insight in how to use it in our trading.

3. TRADING EXAMPLE

We include a real-world example to illustrate how the theoretical aspects are put together to form an effective trading tool.

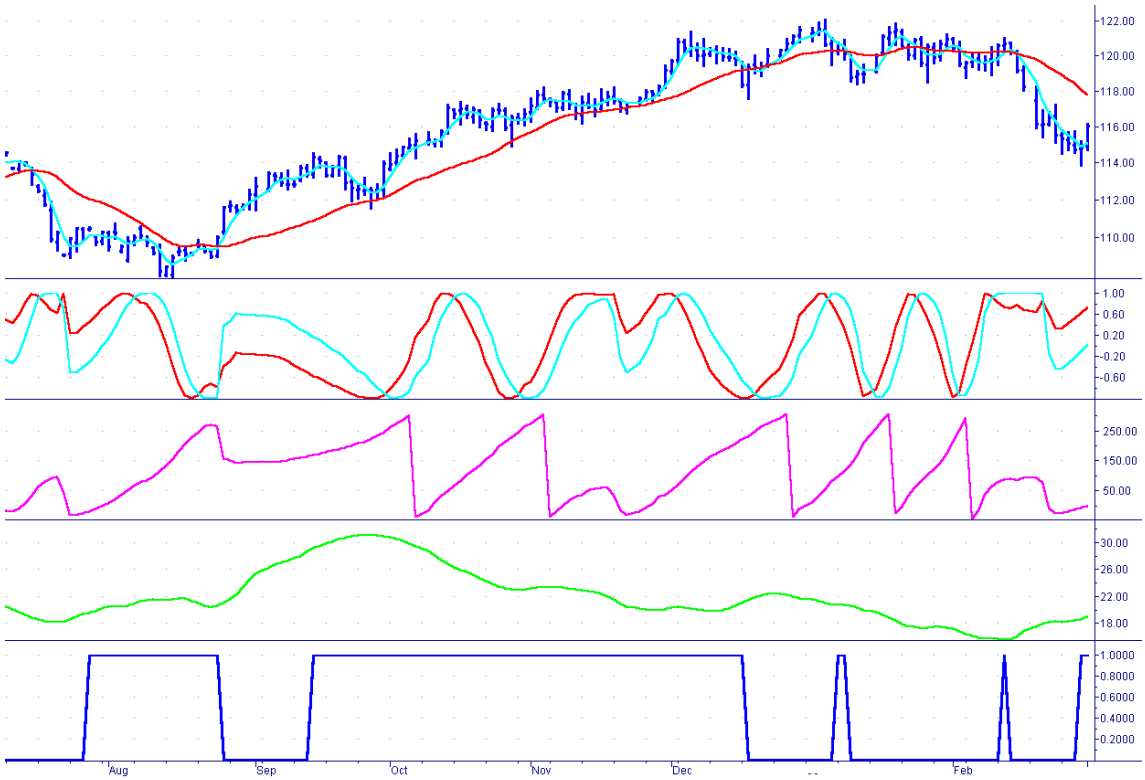

Figure 3. Trading Example

The Instantaneous Trendline is a plot of the median daily price with the dominant cycle removed. This is accomplished by notch filtering the dominant cycle period and also filtering the higher frequency components. This process generates the smooth trendline in Figure 3. The Kalman filter closely follows the median price. When the Kalman filter line stays above the Instantaneous Trendline for more than a half dominant cycle you know you are in a trend. For example, this happens in the second week of September, and the mode shift is shown by the Mode Indicator in Subgraph 5. You know the trend is over when the Kalman filter line again touches the Instantaneous Trendline. This happens, for example, in

the middle of December. In this case, the Mode Indicator drops to zero to indicator the return to the Cycle Mode.

The ***MESA*** Dominant Cycle measurement is shown in subgraph 4. The cycle length increases as time departs from the major turning point in August and then gradually decreases over the period of the Trend Mode. The cycle period is relatively constant, near a 18 bar period, over the duration of the Cycle Mode starting in December. The cycle period is used to compute the phase and the Sinewave Indicator, shown in subgraphs 3 and 2, respectively.

Note the clarity of the Sinewave Indicator signals when the market is in a Cycle Mode. You would not want to trade the Cycle Mode in November.

Now that you understand all the ***MESA*** signals, you may find it less distracting to remove the Phase and Dominant Cycle displays. Doing this, you may find the displays more pleasing and conducive to focusing on the trading signals rather than giving the full in-depth analysis capability.

4. TRADING WITH MESA

MESA automatically adapts to current market conditions by using the ***MESA*** cycle measurement. The goodness of the cycle measurement is best when the cycle length is constant. This means you have stationary data and well focussed cycle energy. The phase display shows a good cycle when it has a composite constant rate change that is consistent with the rate change of phase produced by the measured dominant cycle. The phase is also used to plot sinewaves from it in the Sinewave Indicator display segment. Crossing signals are produced by plotting one sinewave with a 45 degree phase lead, giving an early indication of a cyclic turning point, approximately one-eighth of a cycle early. The price bars are overlaid with two adaptive moving averages, having window lengths of one half and one full dominant cycle. The crossing of these adaptive moving averages signal the direction shifts of the trend.

Having these adaptive tools at your disposal, the following discussions are tips on how best to put them to work for you.

4.1 LOOK AT THE DOMINANT CYCLE

The dominant cycle plot is the best way to assess the validity of the cycle measurement. We urge caution using the cycle measurements when the cycle period is changing and is not stable at a single cycle period.

4.2 THE SINEWAVE INDICATOR GIVES THE EARLIEST SIGNAL

The Sinewave Indicator is designed to give a signal ahead of a cyclic turning point. The best signals occur when the indicator lines look similar to a sinewave at the time the crossing occurs. The Sinewave Indicator

has an erratic pattern when the market is in a trend mode. Unlike most oscillators, the Sinewave tends to not produce false whipsaw signals.

The Sinewave Indicator signal is correlated with the dominant cycle phase. The cycle peak occurs when the phase is at 90 degrees. Therefore, the best entries for short positions should occur for the indicator when the phase is in the vicinity of 90 degrees. Similarly, the best entries for long positions should occur for the indicator when the phase is in the vicinity of 270 degrees, the cycle low point.

4.3 TRADE THE SINEWAVE INDICATOR AT ITS CROSSOVERS

The Indicator should look much like a sinewave at the time the trading signal is taken. A check on this condition is that signal crossover occurs near the 90% point for short entries (and long exits) and near the 10% point for long entries (and short exits).

Remember that the Sinewave Indicator gives signals that are approximately one-eighth of a cycle early. The period of the measured cycle determines how long you should wait to make your entry. If an 8 day cycle is measured, the turning point will likely be the next day, so you must make a quick decision. However, if the measured cycle is 40 days, the indicator will be 5 days early. In this case you should withhold your urge to trade immediately.

4.4 CYCLES HAVE A CONSTANT RATE CHANGE OF PHASE

One definition of a cycle is a constant rate change of phase. That is, there are 360 degrees of phase in a cycle. A 10 day cycle, for example, changes phase at the rate of 36 degrees per day. If the phase does not change uniformly, this is an early indication that the market has switched into a trend mode. The direction of the trend is best shown by the relationship of the two cycle-tuned indicators – the Instantaneous Trendline and the Kalman filter overlaid on the price bars.

4.5 TREND MODE TRADING

Generally, the direction of the trend is obvious. The Sinewave Indicator can compliment trend mode trading by indicating the timing for adding to or lightening of positions.

An indication of a trend mode can be obtained by observing the relationship between the Instantaneous Trendline and the Kalman filter. In a cycle mode the Kalman filter line will criss-cross the Instantaneous Trendline about every half cycle. If the Kalman filter line fails to cross the Instantaneous Trendline within a half dominant cycle (which can often be discerned much earlier when the Kalman filter line shows no hope of recrossing the Instantaneous Trendline), then the onset of a trend can be

declared. The trend is over when the Kalman filter line again crosses through the Instantaneous Trendline.

4.6 TRADEABLE CYCLES

Always examine the amplitude of the measured cycle. It is possible that the cycle is stationary and highly focused (giving a high quality measurement), but that the amplitude of the cycle is not large enough relative to the daily variations to realize a significant amount of profit from the cyclic move.