

## PRODUCT REVIEW

# Neuroshell Trader 5

## WARD SYSTEMS GROUP, INC.

Executive Park West

5 Hillcrest Drive

Frederick, MD 21703

**Phone:** 301 662-7950

**Fax:** 301 663-9920

**Email:** sales@wardsystems.com

**Product:** Neural network technology to predict values and returns on trades.

**Requirements:** 1.8 GHZ Pentium or equivalent, 512 MB RAM, Windows 2000/Vista/XP.

**Price:** Prices start at \$795 for NeuroShell Trader and go up to \$2,495 for NeuroShell DayTrader Professional. Numerous plug-ins are available at \$299 each.

by Dennis D. Peterson

**N**euroShell Trader uses sophisticated neural network technology that you can use in combination with your usual trading rules for backtesting. You can also use the neural network in a standalone fashion to predict a value, such as opening price (or, better yet, percentage change in opening price), and see the payoff (or lack thereof). Besides all of that, NeuroShell Trader also has unique features that make it stand out from the rest of the crowd.

First, it will let you know which of your trading rules are working and which are not. Let's say you have entry rules like  $RSI(10) > 60$ ,  $closing\ price > EMA(12)$  of closing prices, and so on, and you have a set of exit rules. If you select "Rule optimization," NeuroShell will try every combination of rules and show you the combination that worked best. If you pick "Full optimization," it will not only optimize on the rules but the parameters as well. In the example  $RSI(10) > 60$ , the parameters are 10 and 60.

Second is the speed at which NeuroShell finds optimum solutions. NeuroShell uses a technique called a "genetic algorithm" to find the combi-

nation of parameters or rules that work best or, in the case of neural nets, the inputs. It will even optimize stop and limit price, as well as indicator parameters. If you felt inhibited by the time it might take to optimize on a range of values, you will be amazed at how fast NeuroShell works. What might take minutes on other platforms takes just seconds here, and what would normally take hours is completed in minutes in NeuroShell.

For example, full optimization of a system involving seven entry and exit rules, each with an average of three parameters and each parameter having a range of a dozen or more parameter values on average, took approximately nine minutes to find an optimal trading solution. This included the result of three entry rules (with optimized parameters) and four exit rules (with optimized parameters). But with a name like NeuroShell Trader, your main interest probably still is neural nets, so let's keep our discussion on point. Keep in mind that no other software will optimize on rules as well as parameters simultaneously, let alone doing it fast.

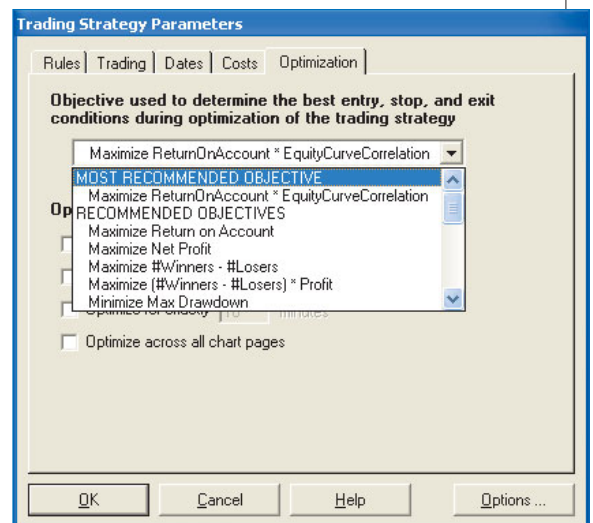
## NEURAL NETS

The idea of neural nets is to take a set of inputs to arrive at a predetermined output. For example, the inputs could be indicators such as the commodity channel index (CCI), the relative strength index (RSI), or closing prices, while the desired output could be the next day's closing price. Neural nets cannot always match your inputs to the desired output(s) without leaving an error between the calculated and desired output(s). So your objective might be to minimize this error in predicting the output, or if you are trading, you might

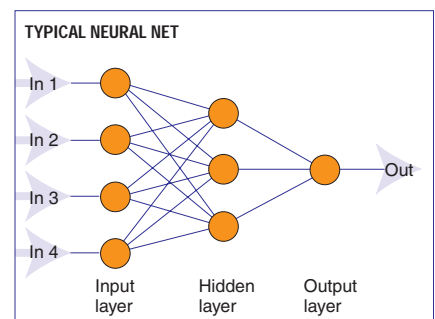
want an objective that includes your equity curve.

NeuroShell Trader does something that is very nifty; it gives you a set of objectives to choose from. In fact, they provide a list of 20 different objectives (Figure 1). NeuroShell's top choice is "Maximize return on account \* Equity curve correlation," but if you prefer, you could select the "Minimize error" option at the bottom of the list.

Aside from controlling objectives, what else might you want to know about neural networks? The first temptation is to believe that a neural net is a cure-all for finding out how a set of values behaves. After all, you might argue, isn't it the idea that you can take a set of inputs to match up against an output? Remember, there is always an error.



**FIGURE 1: TRADING STRATEGY OBJECTIVES.** There are 20 different trading objectives to choose from (top of list shown). After establishing your trading rules you are given the opportunity to customize the desired output you want to achieve.



**FIGURE 2: FEED-FORWARD NEURAL NET.** Weights are given to each of the connections between the neurons. Activation functions (usually nonlinear) are applied inside the neurons. If the activation functions are linear, it is termed a linear model. A signal activation function at the output layer provides a value.

What neural nets do best is find patterns in volatile data, but do you want to feed a neural net the daily closing price data? The kind of volatility associated with the noise of daily price data is too random to be worthwhile, so what you want is smoother data, and thus, indicators such as CCI, RSI, or moving averages (all of which smooth data) are better input candidates. Let me lead you through an example using indicators.

The common picture of neural nets consists of a bunch of inputs feeding neurons in the hidden layer. The earliest forms of a neural net were termed “feed-forward” (Figure 2). The defining topology of this early form of a neural net is that while all hidden-layer neurons can see all of the inputs, none of the neurons are feeding backward; hence the name feed-forward. In addition, none of the hidden neurons are interacting.

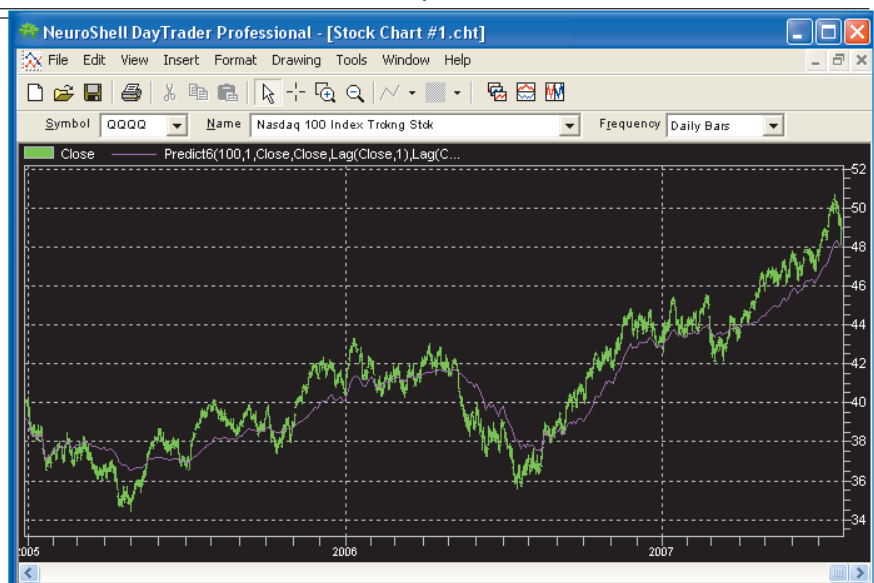
More sophisticated neural nets have the hidden neurons interacting with one another. NeuroShell uses interacting hidden neurons. Rather than having a fixed number of hidden neurons, NeuroShell adds neurons one at a time, up to a limit you can specify — the default is 10. The NeuroShell default for a prediction algorithm is Turboprop2, a variant of a neural network algorithm called cascade correlation.

Another bit of advice for using neural nets is to make the output an up or down condition, such as greater or less than a threshold, as opposed to an actual value such as closing price. When using the prediction wizard, the default for an output is a greater-than or less-than condition for entering/exiting trades. NeuroShell then automatically goes one step further by optimizing the value for greater than/less than while training the net.

## USING NEURAL NETS

There are two ways to have neural nets included in your analysis. The first is to ask for a prediction. Typically, you will start with a price/volume chart. From the menu line, choose “Insert new prediction” from the dropdown list. The prediction wizard will guide you through all of the steps necessary to set up a prediction.

The second way is to choose as an



**FIGURE 3: ADAPTIVE MOVING AVERAGE USING ADAPTIVE NET INDICATORS (ANI).** Using ANI you can build adaptive moving averages. Daily price bars for QQQQ are in green and the adaptive moving average is shown in purple. If you went long when price was above the average and went short when it was below, except for a bit of choppiness you wouldn't have done too badly.

input, an indicator that is a neural net when using a trading strategy. You can have the usual suspects such as moving average, CCI, the moving average convergence/divergence (MACD), and so forth, but include a neural net as part of your trading strategy.

When you finish with a prediction, the results will appear as a subchart and also be available as an indicator. Inserting a new trading strategy will allow you to use the prediction as an indicator in your strategy. But there are also two add-ons that you might think about, Adaptive Net Indicators (ANI) and Neural Nets (NI). These add-ons have features that are not part of the initial installation.

For example, in the case of ANI you have the option to include today's value and values for previous days. But you can go one step further if you choose more than one input. With two inputs you could have one be the last five days and the second be the five days prior to the first five. Then, if you want, you can weight the inputs. Unique to these add-ons is the feature that the optimization will not only cover all of your trading rules and parameters but also how many days to predict in the future and the size of the training set. You can use ANI to build an adaptive moving average (Figure 3).

To build the adaptive moving average like the one shown in Figure 3, the neural network software is trying to predict the next day's close by using a training set that is 100 bars back from

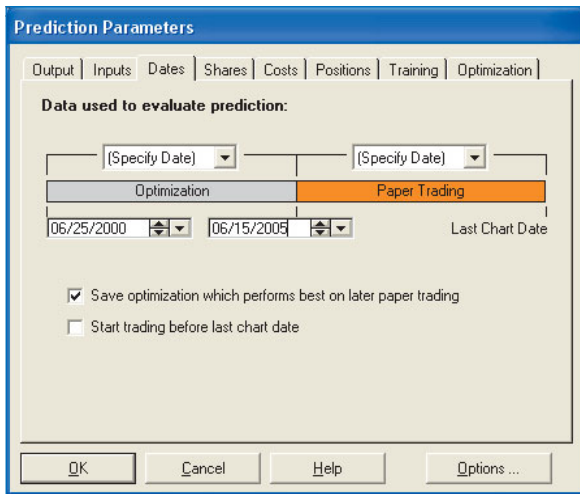
each bar (the neural net is actually re-training for each bar) using as inputs today's closing price, as well as the previous five, and then weighting the inputs with the most recent getting the most weight. Looking at the performance it is impressive. In all, it's pretty powerful stuff.

Just in case you were curious, ANI is a type of GRNN (general regression neural network) or PNN (probabilistic neural network, based on the work of Donald Specht), and the output is between +1 and -1. Using +1 as buy and -1 as sell, the output tells you how likely a value you have identified is going to occur.

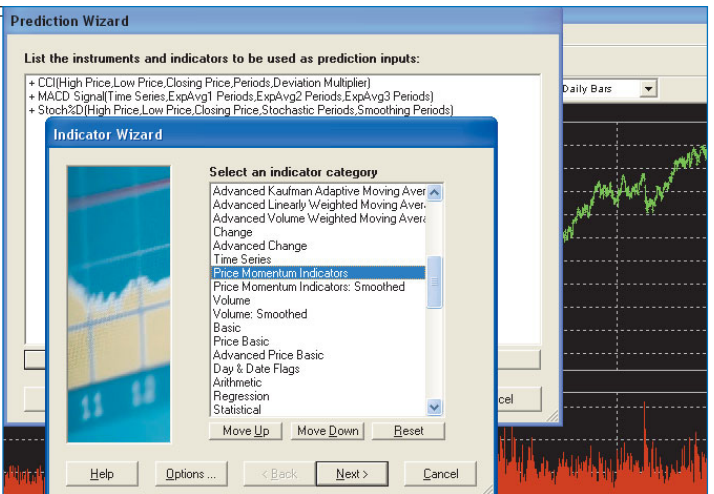
## TRAINING VS. OPTIMIZATION

NeuroShell's ability to optimize makes it something you will want to use often. But do you optimize on parameters relative to the training or paper-trading? Just how do you make effective use of paper-trading while optimizing?

Putting aside this question for the moment, you'll need to pick the dates for training vs. paper-trading. In the prediction wizard, one of the screens you can make inputs to is “Dates” (Figure 4). You can pick dates for training vs. paper-trading, with the limitation that the end of training is the beginning of paper-trading. Remember you are looking for patterns, and bull vs. bear markets have different patterns. You might consider just training on a bull market rather than finding a pattern that works on both bull and bear markets.



**FIGURE 4: TRAINING VS. PAPER TRADING.** This screen of the Prediction Wizard lets you modify a number of prediction parameters. Using the “(Specify Date)” option, you can manually determine the start and stop dates for training, seen here as the “Optimization” period. Note the end of training is the beginning of paper-trading while the end of paper-trading is the last day on the chart (although you can add an additional out-of-sample testing period by checking “Start trading before last chart date”). Optimization is stopped when the best paper-trading results occur since the “Save optimization which performs best on paper trading” option is checked.



**FIGURE 5: INDICATOR WIZARD.** The list of indicator categories for inputs is substantial. Keep in mind that each category has a dozen or more specific indicators. The highlighted category, “Price momentum indicators,” contains the inputs you see in the background (CCI, MACD, and stoch%D). If you insert an indicator into your price chart, you end up going through the same indicator wizard that you use when picking an indicator for prediction input. This minimizes the number of user interfaces you need to learn.

So just how do you make effective use of paper-trading while optimizing? A hint can be found in one of the items you can check: “Save optimization that performs best on paper trading.” What NeuroShell found is that while optimizing on the parameters in the trading set, each solution would improve paper-trading results but only to a limited extent. Paper-trading results improve to some point and then get worse as training optimization goes on and overfitting begins. As a result, NeuroShell stops optimizing when it sees that the objective result from paper-trading starts getting worse.

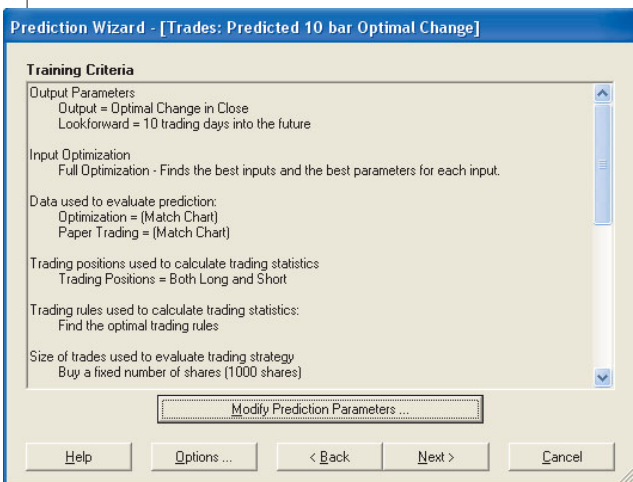
### PREDICTION SETUP

The first step in setting up predictions is to open a price chart. In this case I chose a price and volume template. The next step I took was to go to the menu, select “Insert,” and from the dropdown list I selected “New prediction.” This action puts you in the prediction wizard. After an initial screen, you’ll be asked to provide inputs, and when you click on “Add inputs,” you’ll be in the indicator wizard (Figure 5). The choices for inputs are enormous, as indicated on the screen capture.

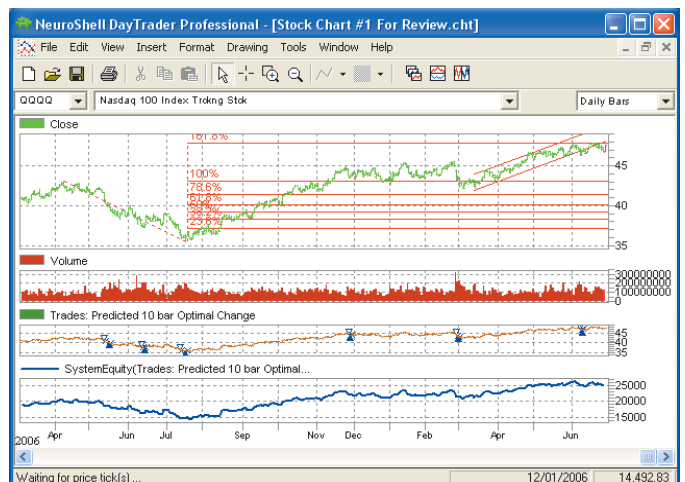
After establishing your inputs, the next

screen is “Training criteria,” and you’ll see at the bottom of this screen a button labeled “Modify prediction parameters” (Figure 6). Click on “Modify…” and you get the screen shown in Figure 4 where you can establish nine different items such as dates for training versus paper-trading as well as how many days out you’ll want to predict.

After establishing your prediction parameters by either accepting the defaults or modifying them, click on “Next” to start the prediction process. The result appears on your chart (Figure 7, with the subchart just below volume



**FIGURE 6: TRAINING CRITERIA FOR PREDICTION.** The text below the heading “Training criteria” summarizes the criteria/parameters that will be used in the prediction. If the default is not what you want, click on “Modify prediction parameters” to get the screen shown in Figure 3. The “Back” and “Next” buttons are a convention used throughout the NeuroShell interface so you can either move on to the next step of the wizard or go back and change what you have done.



**FIGURE 7: PRICE CHART.** Daily QQQQ price data is overlaid with a Fibonacci retracement and channel (upper right). Below the price chart are three subcharts: volume, trades resulting from inserting a prediction, and equity resulting from the trades.

## PRODUCT REVIEW

subchart). You can have multiple price series on your chart. Drawing tools are available such as Fibonacci retracement as well as channels. You have to add “System equity” from the “Trading strategy system information” by clicking on “Insert indicator” from the dropdown menu under “Insert” on the menu line. Of course, you can save this chart as a template to open other price series.

You might have noticed a repetition in the way NeuroShell is used. That’s because you basically have three wizards (prediction, trading strategy, and indicators) and as you go through the steps in using one, you either back up or continue by choosing.

### INDICATORS

NeuroShell has an impressive list of indicators as well as some slick add-ons. To build your own indicators, you can use one of two different methods: top down or bottom up. Bottom up is the easier to explain. Suppose you wanted an indicator that was the difference between two moving averages. The first step would be to insert each of the moving averages on your chart. The second would be to choose the subtraction function from the arithmetic category. The indicator wizard will provide a screen that allows you to select the moving averages as the arguments to the subtraction function.

NeuroShell uses functions for everything; there is no engineering notation syntax supported. You can’t write

“ $A=B+C$ ,” but you can write Add (B, C). If you can program in one of the standard languages such as C, NeuroShell provides an interface for your dynamic link libraries (DLLs). If you get stuck, someone at NeuroShell will help you for free and even take written requests as long as they are not too time-consuming. The staff is smart, friendly, and experienced, so you’ll probably get an answer.

You also need to consider the add-ons. The list is impressive coming from both third parties and Ward Systems itself, and the website has short as well as longer descriptions. To get an idea of what the possibilities are, here are just a few offered by Ward:

- *Adaptive net indicators:* Neural nets especially adapted to pattern recognition, some of which automatically include lags of inputs. Useful for building your own adaptive moving averages.
- *Adaptive indicator set 1:* A set of indicators that users requested including chaos indicators, an indicator that gives the phase of the moon, and curve-fitting trendline indicators (W.D. Gann might be intrigued by this add-on).
- *Neural indicators:* Classification neural nets that give you the probability that the current situation is a buy or sell opportunity. These nets don’t predict any price, but give you a direct signal probability. Some are “recurrent nets” that automatically

look back in time.

- *Turning points:* A set of indicators based on the concept of finding local peaks and valleys in a price series.

### DATA SOURCES

NeuroShell has a capability that only a few programs possess. It will search your hard drive for file formats it understands, like MetaStock. You don’t have to do anything except tell the data sources software to scan for directories. NeuroShell also interfaces with a number of the most popular data servers: eSignal, Quote.com, Prophet. You can mix different data sources on the same chart, for example, having daily data from a server and end-of-day data from your hard drive on the same subchart.

### THE EDGE

If you are looking for a competitive edge, this technology is a must. Even if you are just trying to make a little money, the investment in the software is worth it. If you have other software you will find the interface is a bit different, but nothing you can’t sort out in short order. There are some very neat things this software can do that are unique. Try it — I think you’ll like it.

*Dennis D. Peterson is a Staff Writer for STOCKS & COMMODITIES.*

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