

Developing professional-quality applications with MATLAB

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Undocumented Matlab.com

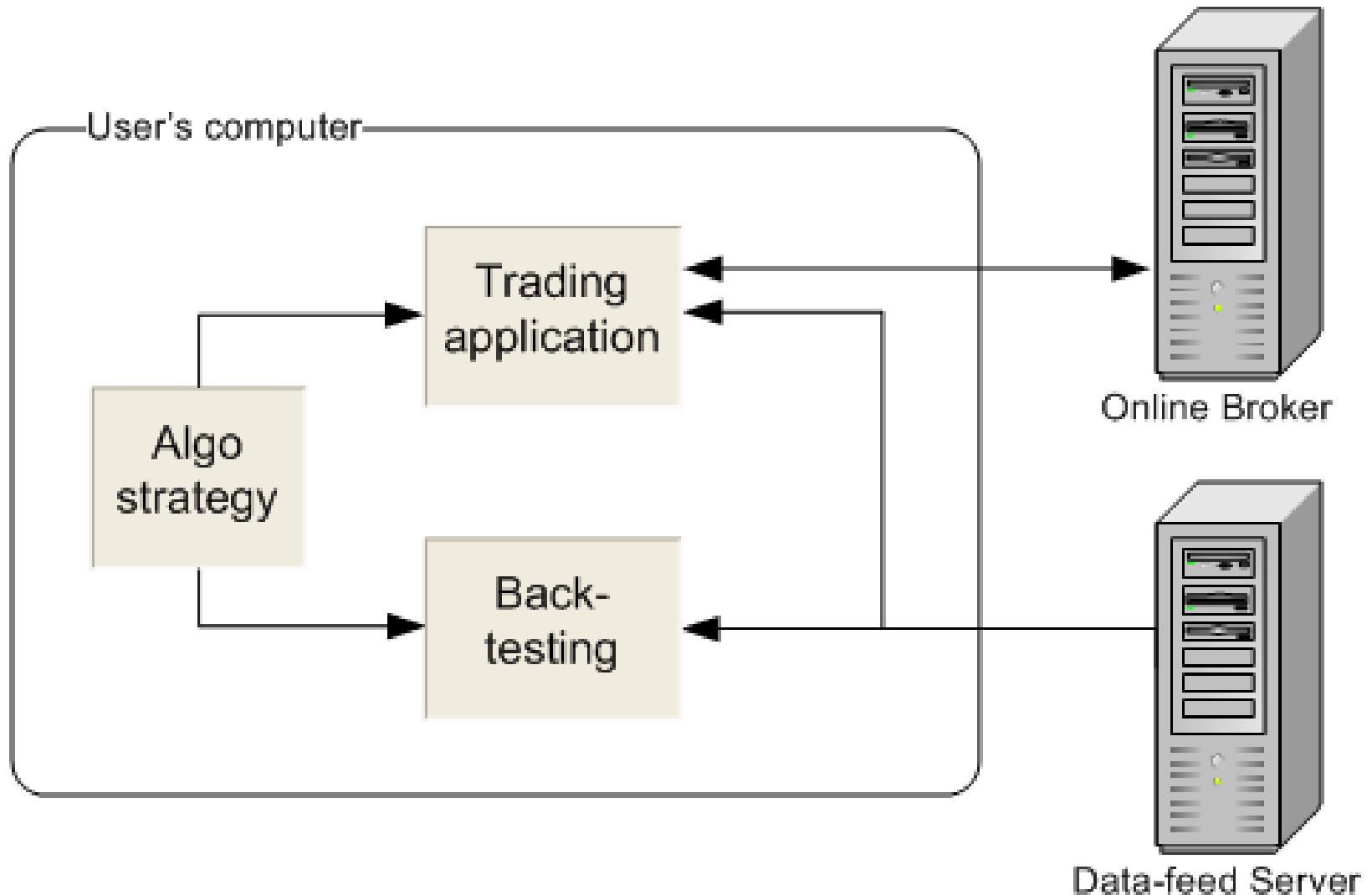
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Common challenges

- ✓ RAD
- ✓ Functionality
- ✓ Robustness
- ? Usability
- ? Performance

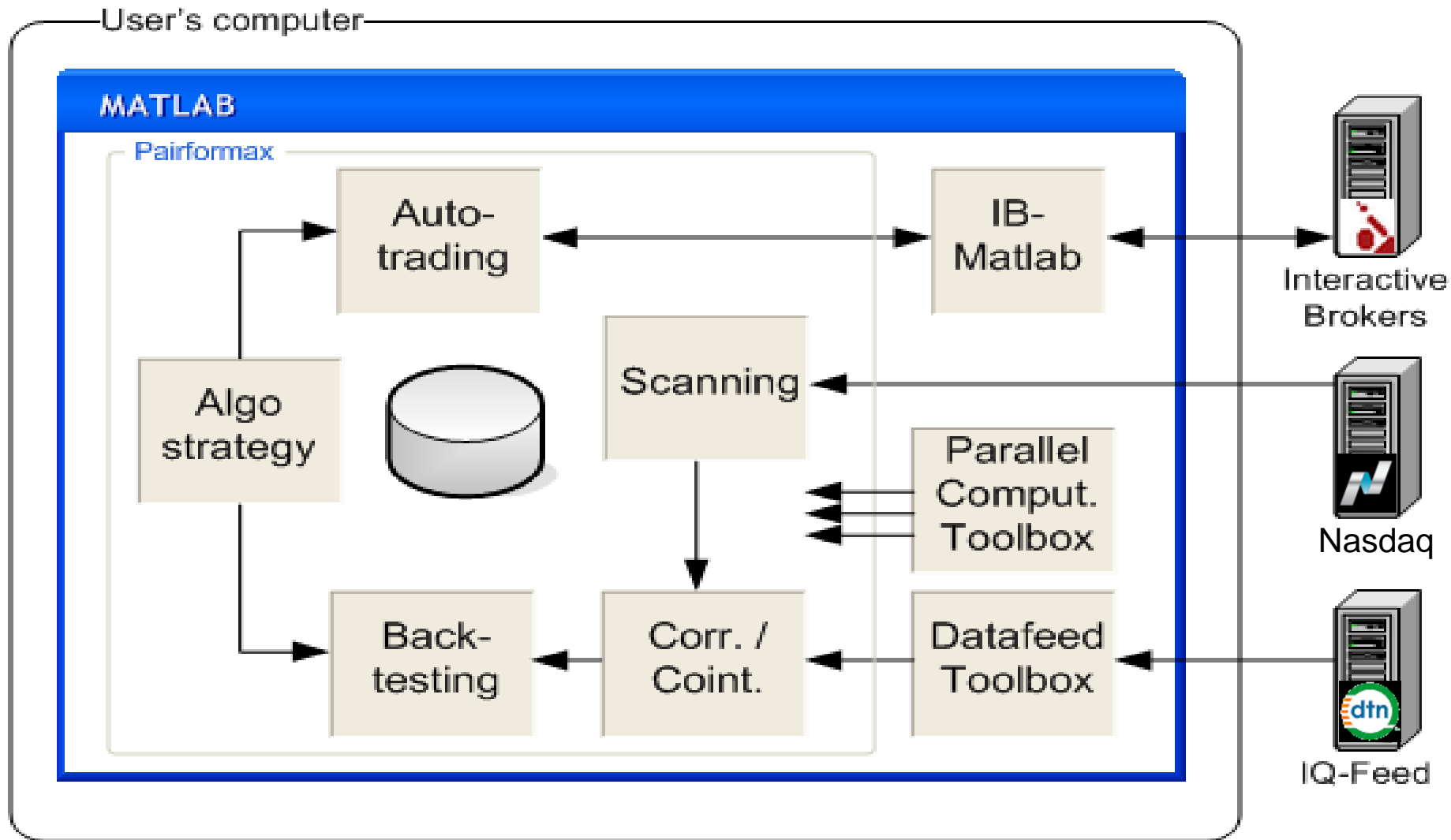
General trading application design



Pairformax process flow

- 1. Scan** for applicable stocks
- 2. Download** historical data
- 3. Correlate** – find well-correlated pairs
- 4. Backtest** various user-defined strategies
- 5. Select** pairs/strategies to trade
- 6. Trade** the selected pairs/strategies

Pairformax main components



Data challenges

- Huge amounts of data
 - $3K \text{ stocks } (^2) * 6 \text{ data items / bar } *$
 $8 \text{ bytes (double) / bar } *$
 $4K \text{ 30-min bars / year } * 5 \text{ years}$
 - Multiple backtesting strategies
 - Impractical to process everything in sequence
- Data quality
 - gaps, inaccuracies, misaligned data
- Time constraint
 - Real-time scanning during auto-trading & research
 - Interactive backtesting design cycles

Improving run-time performance

- Data reduction
 - Several processing steps
 - Tighter config constraints
- Wherever possible:
 - Cache data
 - Vectorize processing
 - Employ early bail-outs
- Hardware: add RAM, use SSD
- Separate machines for backtest R&D, auto-trading
- Parallel processing
 - Use Parallel Processing Toolbox
 - `parpool(feature('numcores'))`
 - Reduce broadcast data to minimum
 - Especially important for tasks having I/O waits

GUI challenges

- Display large amounts of results data
- Interactivity / reactivity
- Usability

Displaying large amounts of data

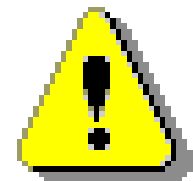
- General concepts
 - Focus user attention on important data (summary, anomalies)
 - Hide less-important data by default
 - Combination of tables (quantitative) & charts (qualitative)
 - Enable data zoom-in (detachable chart, axes zoom, table click)
- Sorting, filtering & searching in data tables
 - **Extremely** important
 - Pre-sort data tables by descending value (best at top)
- Provide an integrated search-box
- Use tabs, flex-box panels (*uiextras* on FEX)
- Summarize data in separate tabs, sub-tables

Improving usability

- User should be able to configure GUI as much as possible
- Remember user preferences (`setpref/getpref`)
- Automatically reload last-used data
- Intuitive flow (left→right, top→bottom)
- Disable or hide figure/panel/controls during processing:
 - `enableDisableFig` (FEX)
 - Ensure you restore in all exit conditions, including early bail-outs/exceptions
- Avoid data overload – hide non-critical data
 - Use tooltips, tabs, closed/hidden panels etc.
 - Remove unnecessary scrollbars, panel/table borders, unused controls
- Use appropriate Java controls
 - date/folder selector, spinner, tree, search box, password field
- Use colors/fonts consistently
 - Deviate to emphasize, e.g. backtesting summary sub-table headers (HTML)

Caveat emptor...

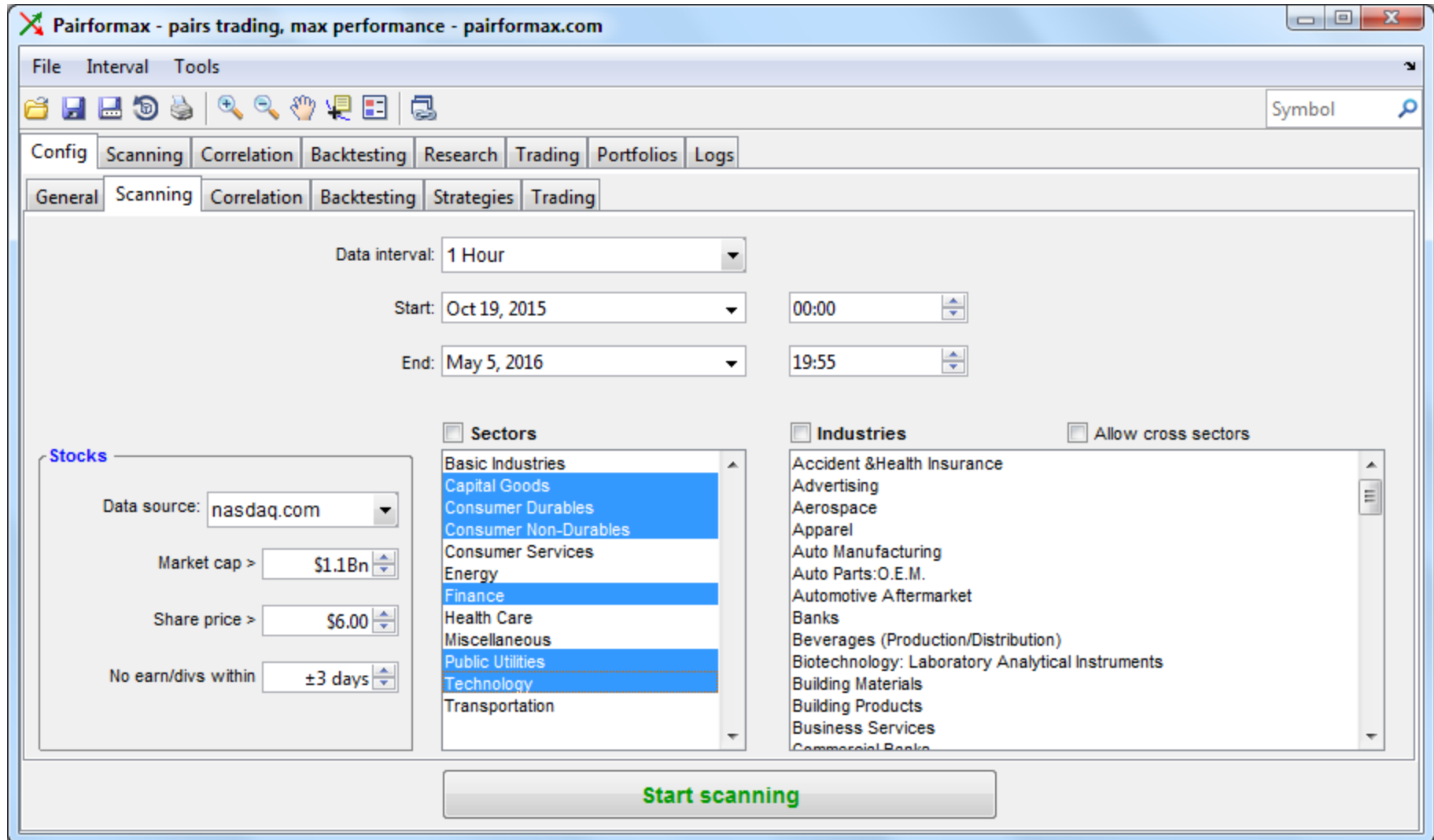
- Improved GUI functionality requires Java controls
- Using Java controls in MATLAB is:
 - Free & super-easy, but:
 - Undocumented
 - Unsupported
 - May break in some future MATLAB release
- Use such features if you:
 - Accept the risk that MathWorks will not fix bugs
 - Are willing to code without MathWorks' official support
 - Need professional GUIs today
 - Don't care about future compatibility (e.g., compiling an exe) or:
 - Accept the risk that re-coding may be required in the future



Improving GUI performance

- Use `uitable('v0')` or `JTable`, not standard `uitable`
- Use `drawnow` sparingly
 - Not too often, to avoid flicker/slowdowns
 - Not too seldom, to let the user see ongoing progress
- Improve the *perceived* performance
 - Intuitive flow
 - Postpone non-visible updates to end of processing
 - Ongoing feedback (console, progress bars, GUI update)

Pairformax screenshots + live demo



Pairformax screenshots + live demo

The screenshot displays the Pairformax software interface. The window title is "Pairformax - pairs trading, max performance - pairformax.com". The interface includes a menu bar (File, Interval, Tools), a toolbar with various icons, and a tabbed navigation system with tabs for Config, Scanning, Correlation, Backtesting, Research, Trading, Portfolios, and Logs. The "Trading" tab is active, showing a list of strategies on the left: "strategy on spread amount", "strategy on P&L", and "test strategy".

The "test strategy" configuration is shown in the main area. The "Name" field is set to "test strategy". The "Overview" tab is selected, showing the following criteria:

- Sell X, buy Y: ("A")**
 - Entry criteria**
 - Z score > 0.50 and
 - Spread amount increases for 3 consecutive bars and
 - RSI is on an up-trend for 2 consecutive bars
 - Take-profit criteria**
 - Profit of 2.5% or more
 - Stop-loss criteria**
 - Loss of 1.2% or more trailing
- Buy X, sell Y: ("B")**
 - Entry criteria**
 - Z score < -0.50 and
 - Spread amount decreases for 3 consecutive bars and
 - RSI is on a down-trend for 2 consecutive bars
 - Take-profit criteria**
 - Profit of 2.5% or more
 - Stop-loss criteria**

Buttons for "New", "Copy", and "Del" are located at the bottom left. A large "Rerun backtest" button is at the bottom center. The "Symbol" field is empty, and the "A=>B" button is visible in the top right of the strategy configuration area.

Pairformax screenshots + live demo

Pairformax - pairs trading, max performance - pairformax.com

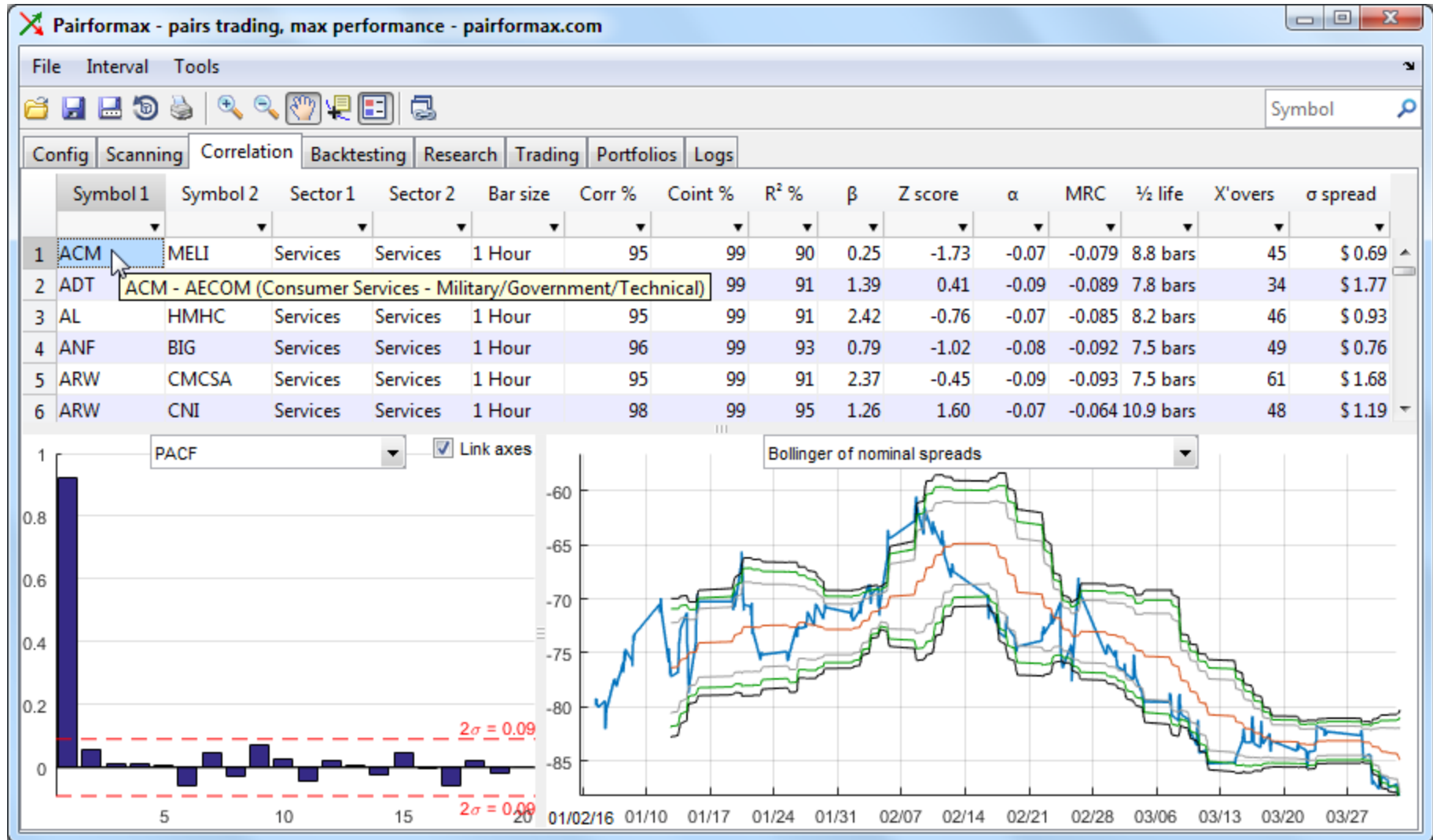
File Interval Tools

Symbol

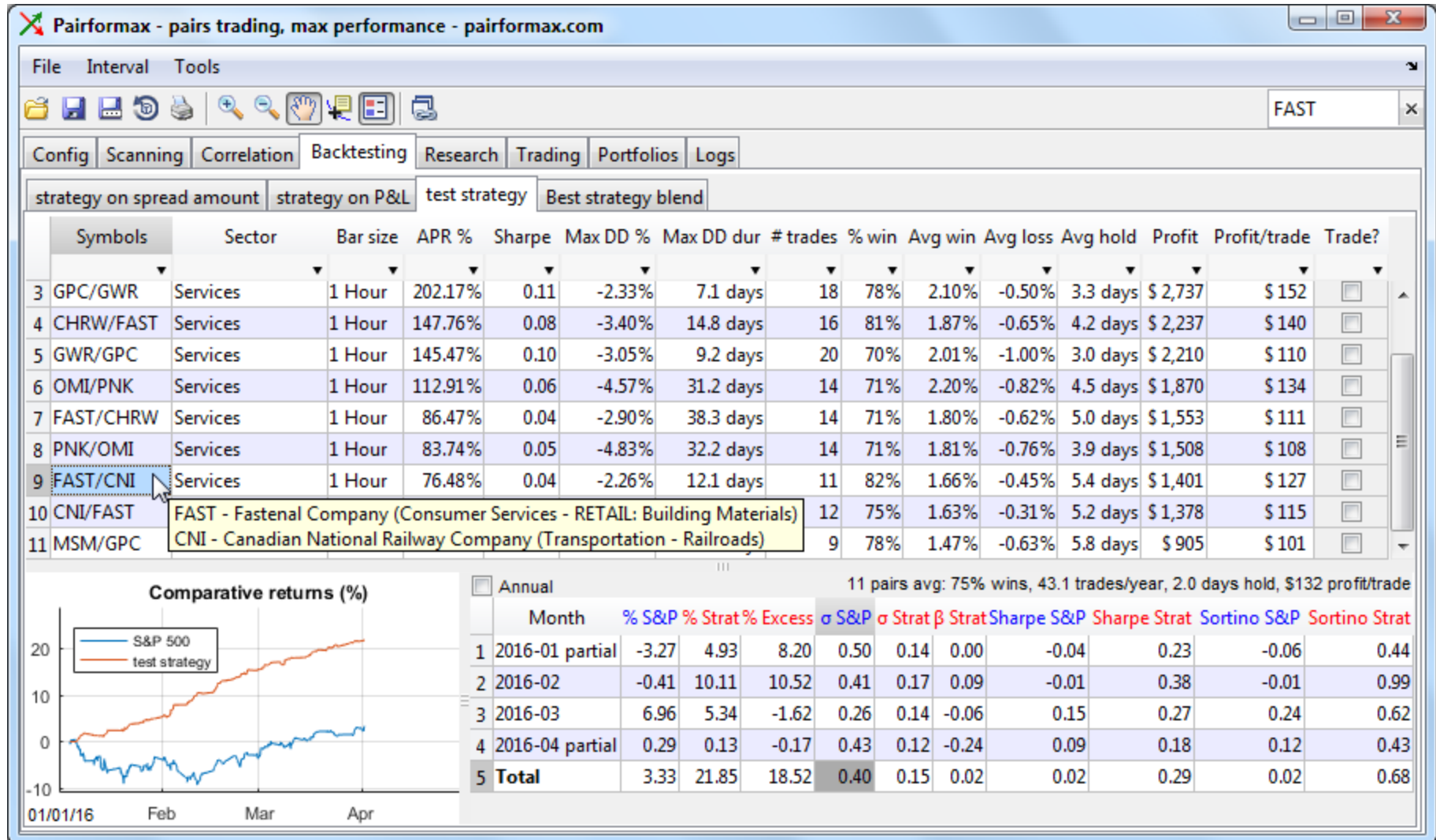
Config Scanning Correlation Backtesting Research Trading Portfolios Logs

| | Sym... | Company | Sector | Industry | Country | Market Cap | P/E | Price | Change | Volume | Next div x date | Next earn date |
|----|--------|---------------------------|------------------|--------------------------|--------------|-------------|------|-----------|--------|----------|-----------------|----------------|
| 1 | A | Agilent Technologies,... | Healthcare | Medical Laboratories... | USA | \$ 13,366 M | 29.4 | \$ 40.94 | 1.04% | 493 K | TBA | 2016-05-16 |
| 2 | AAAP | Advanced Accelerator... | Healthcare | Diagnostic Substances | France | \$ 1,375 M | ~ | \$ 34.00 | -2.21% | 3 K | TBA | TBA |
| 3 | AAL | American Airlines Gro... | Services | Major Airlines | USA | \$ 19,909 M | 3.0 | \$ 33.03 | -0.53% | 6,100 K | TBA | TBA |
| 4 | AAN | Aaron's, Inc. | Services | Rental & Leasing Ser... | USA | \$ 1,862 M | 13.8 | \$ 25.44 | -0.82% | 194 K | TBA | TBA |
| 5 | AAP | Advance Auto Parts Inc. | Services | Auto Parts Stores | USA | \$ 11,443 M | 24.4 | \$ 150.95 | -3.14% | 911 K | TBA | 2016-05-19 |
| 6 | AAT | American Assets Trust... | Financial | REIT - Retail | USA | \$ 1,887 M | 67.7 | \$ 41.62 | -0.31% | 47 K | TBA | TBA |
| 7 | ABB | ABB Ltd. | Industrial Goods | Diversified Machinery | Switzerland | \$ 47,865 M | 24.5 | \$ 20.54 | -0.72% | 667 K | 2016-07-08 | TBA |
| 8 | ABBV | AbbVie Inc. | Healthcare | Drug Manufacturers ... | USA | \$ 99,752 M | 18.4 | \$ 61.86 | 0.65% | 3,484 K | TBA | TBA |
| 9 | ABG | Asbury Automotive G... | Services | Auto Dealerships | USA | \$ 1,274 M | 8.9 | \$ 57.15 | -0.12% | 130 K | TBA | TBA |
| 10 | ABM | ABM Industries Incorp... | Services | Business Services | USA | \$ 1,850 M | 37.6 | \$ 32.53 | -0.67% | 169 K | TBA | 2016-06-07 |
| 11 | ABT | Abbott Laboratories | Healthcare | Medical Appliances ... | USA | \$ 58,324 M | 26.8 | \$ 38.28 | 0.47% | 7,632 K | TBA | TBA |
| 12 | ABX | Barrick Gold Corporati... | Basic Materials | Gold | Canada | \$ 20,341 M | ~ | \$ 17.75 | 1.66% | 10,947 K | 2016-05-26 | TBA |
| 13 | ABY | Abengoa Yield plc | Utilities | Electric Utilities | United Ki... | \$ 1,762 M | ~ | \$ 17.00 | -0.03% | 177 K | TBA | 2016-05-09 |
| 14 | ACC | American Campus Co... | Financial | REIT - Residential | USA | \$ 6,066 M | 60.6 | \$ 46.65 | 0.97% | 403 K | TBA | TBA |
| 15 | ACGL | Arch Capital Group Ltd. | Financial | Property & Casualty ... | Bermuda | \$ 8,638 M | 17.4 | \$ 70.41 | -0.23% | 103 K | TBA | TBA |
| 16 | ACH | Aluminum Corporatio... | Basic Materials | Aluminum | China | \$ 8,114 M | ~ | \$ 8.02 | -0.37% | 15 K | TBA | TBA |
| 17 | ACHC | Acadia Healthcare Co... | Healthcare | Specialized Health Se... | USA | \$ 5,100 M | 36.8 | \$ 58.45 | -1.33% | 229 K | TBA | TBA |
| 18 | ACM | AECOM | Services | Technical Services | USA | \$ 4,860 M | ~ | \$ 32.37 | 0.97% | 405 K | TBA | 2016-05-10 |
| 19 | ACN | Accenture plc | Technology | Information Technol... | Ireland | \$ 75,009 M | 19.8 | \$ 114.01 | 0.41% | 670 K | TBA | 2016-06-23 |

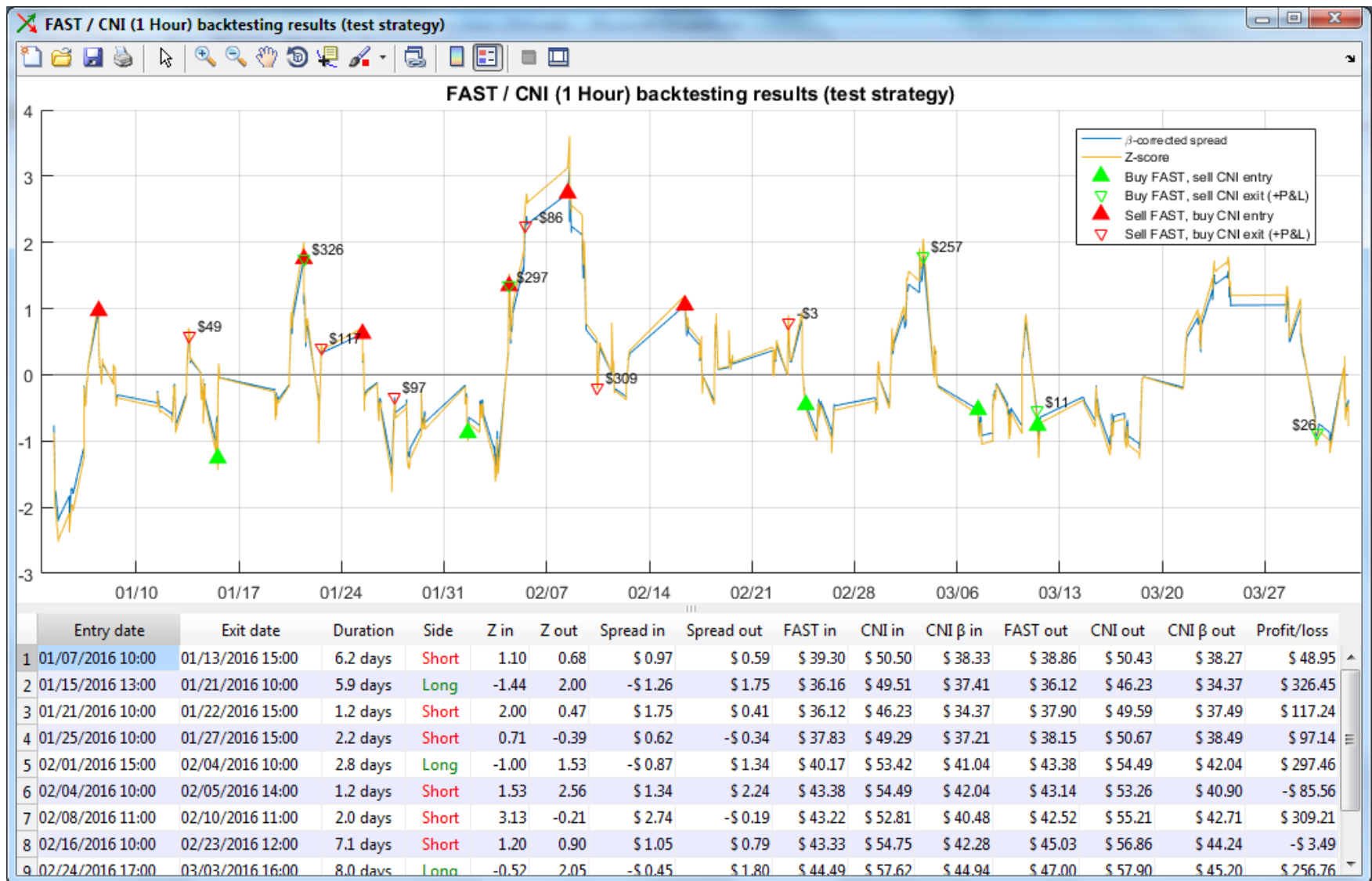
Pairformax screenshots + live demo



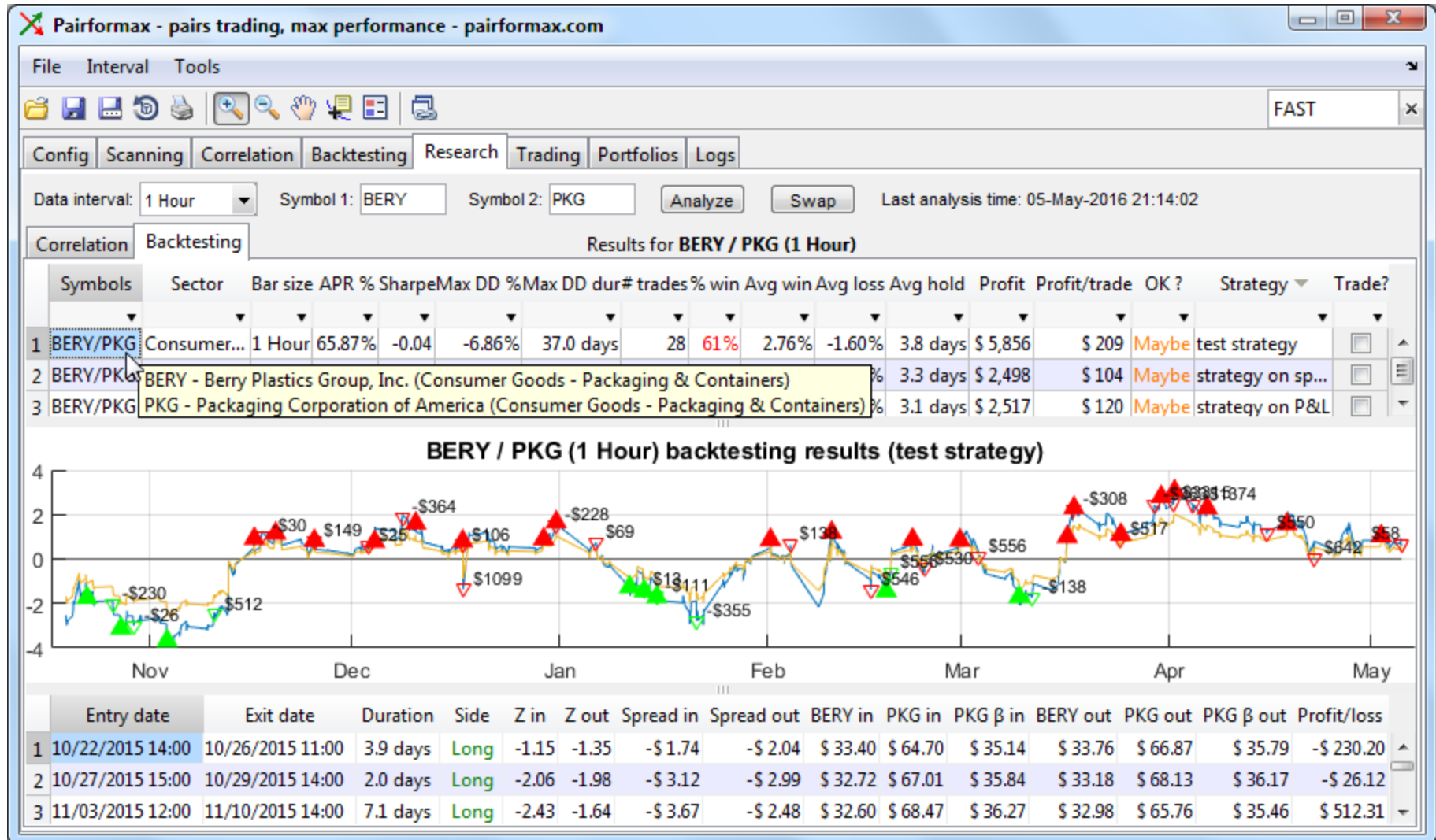
Pairformax screenshots + live demo



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Pairformax screenshots + live demo

| P&L | | + PROFILE | | Margin | | | | + ACCOUNT | |
|----------------|--------------|------------|-----------|-------------|------------|------------|-------|-----------|--|
| Total P&L | 8,025 | Unrealized | 7.2K | Net Liq | 2.9M | Excess Liq | 2.7M | | |
| | | Realized | 842.4 | Maintenance | 168.0K | SMA | 0 | | |
| P&L | Portfolio | POS | MKT VAL | AVG PX | UNRLZD P&L | LAST | CHNG | | |
| Realized P&L | 564 DSW | 0 | | | | 26.82 | +0.53 | | |
| | 270 TXRH | 0 | | | | 43.46 | -0.94 | | |
| Unrealized P&L | 53 EA | -1,190 | -76,910 | 64.674 | 53 | 64.63 | +1.67 | | |
| | -388 CMCSA | -1,214 | -75,317 | 61.728 | -378 | 62.04 | +0.32 | | |
| | 3,803 KEX | 1,251 | 79,013 | 60.121 | 3,802 | 63.16 | +3.04 | | |
| | -507 PCG | 1,267 | 74,512 | 59.187 | -476 | 58.81 | -0.40 | | |
| | -1,085 CAVM | -1,307 | -76,094 | 57.376 | -1,102 | 58.23 | +0.84 | | |
| | 470 AEE | -1,541 | -74,592 | 48.666 | 403 | 48.40 | -0.31 | | |
| | 3,002 VRNT | 2,207 | 77,620 | 33.93 | 2,737 | 35.17 | +1.36 | | |
| 1,844 ACIW | 3,842 | 77,071 | 19.523 | 2,064 | 20.05 | +0.47 | | | |
| USD CASH | | | 2,886,951 | | | | | | |

Products & services used

- MathWorks
 - MATLAB
 - Datafeed Toolbox
 - Parallel Computing Toolbox
 - Optional: Financial, Database, Optimization, Compiler Toolboxes
- 3rd-party (MATLAB)
 - IB-Matlab Toolbox
 - Spatial Econometrics Toolbox
 - GUI Layout Toolbox
- 3rd-party (other)
 - Interactive Brokers
 - DTN IQ-Feed
 - Nasdaq.com, FinViz.com

Conclusions

- MATLAB is **not** inherently ‘slow’
- MATLAB GUI is **not** inherently ‘simplistic’
- MATLAB can be used to create professional-quality user-facing applications, while enjoying MATLAB’s benefits (RAD, functionality, reliability)
- As with everything in life, there are tradeoffs:
 - For better performance, invest extra code development time
 - For better appearance, invest extra design time
 - For better usability, use unsupported Java controls

Danke schön!

<http://UndocumentedMatlab.com/files/Pairformax-Expo-2016.pdf>

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