

Developing professional-quality applications with MATLAB

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Undocumented Matlab.com

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Common challenges

✓ RAD

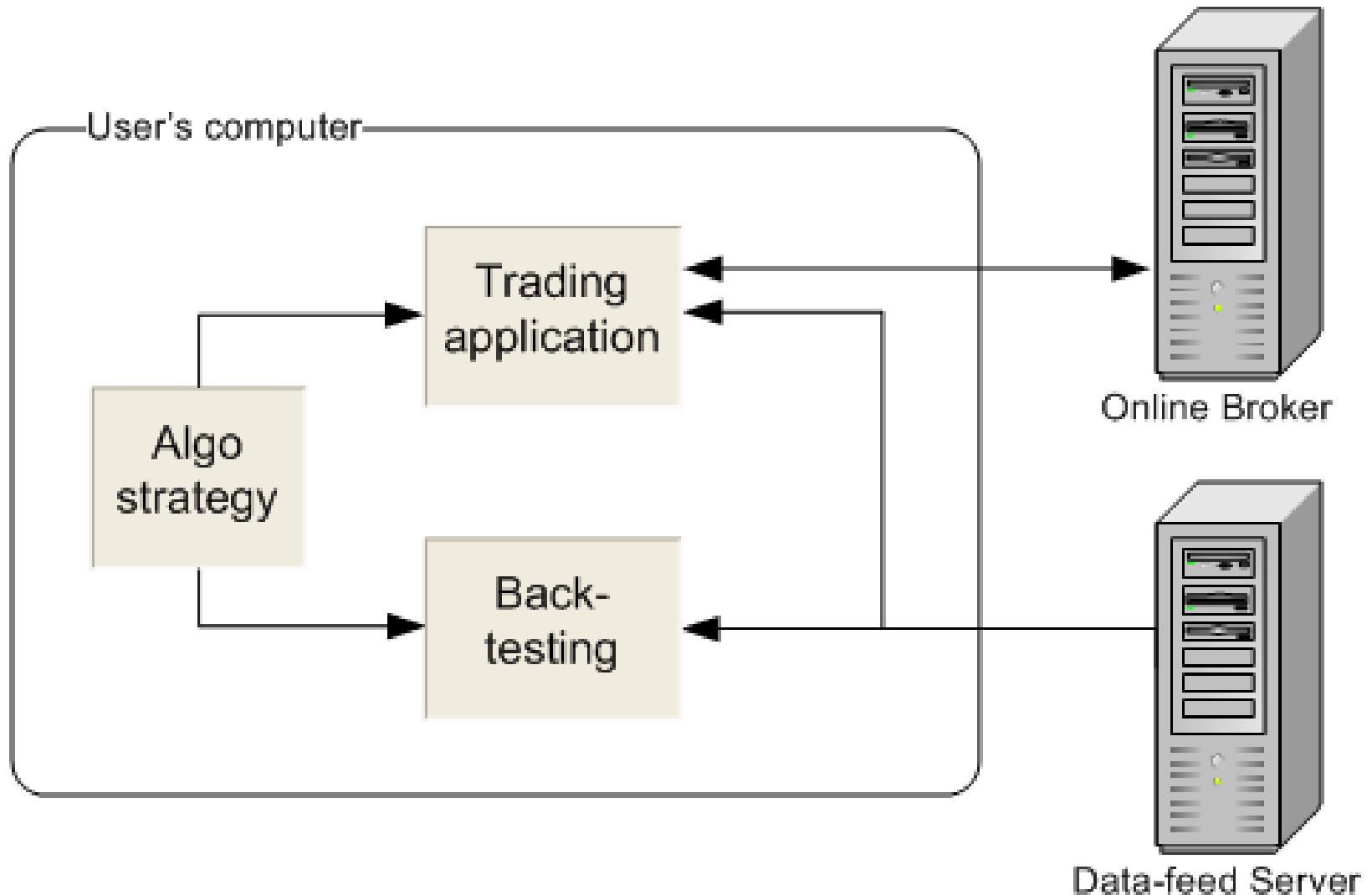
✓ Functionality

✓ Robustness

? Usability

? Performance

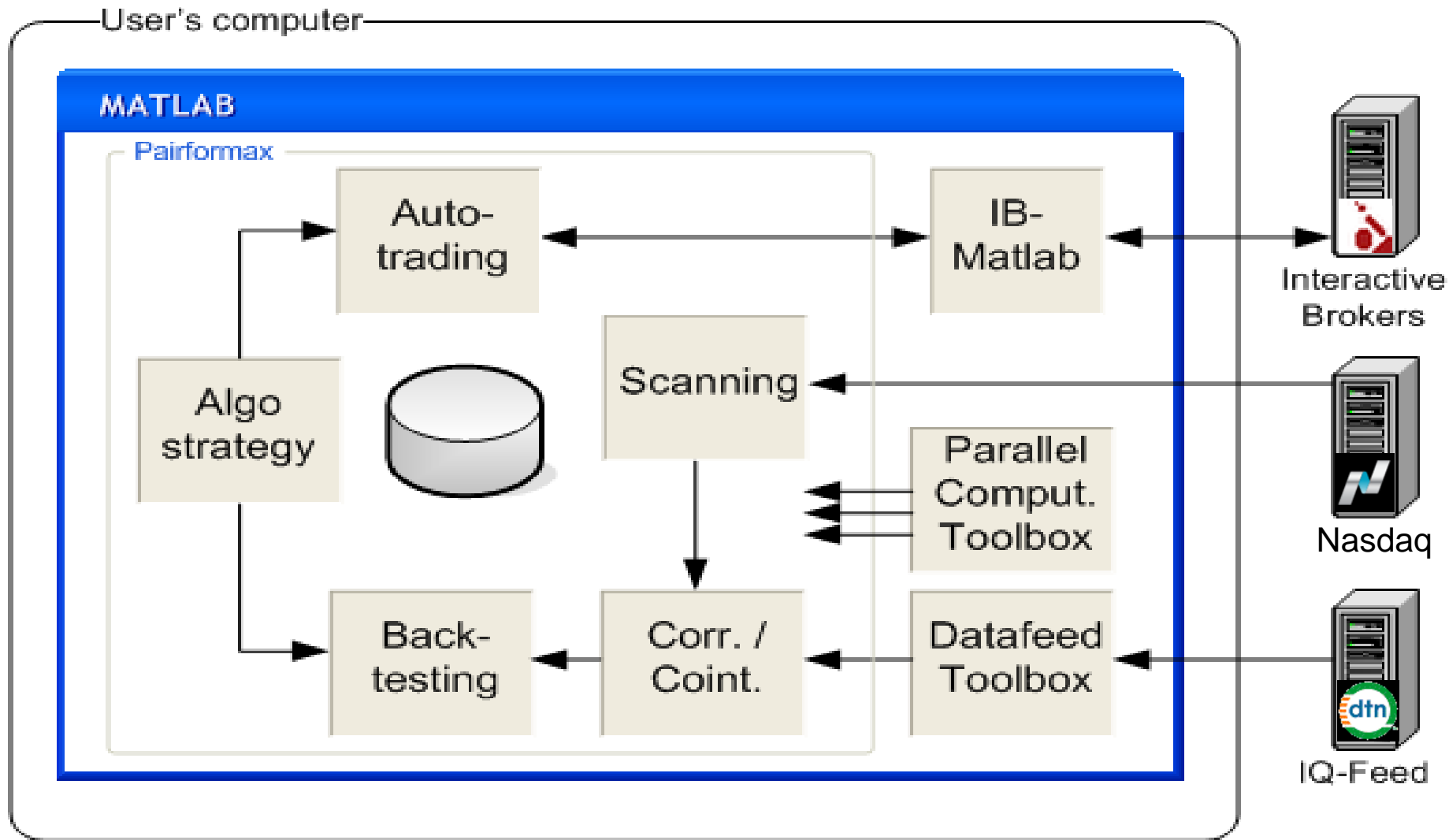
General trading application design



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

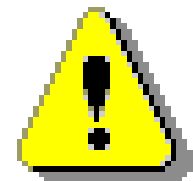
- General concepts
 - Focus user attention on important data (summary, anomalies)
 - Hide less-important data by default
 - Combination of tables (quantitative) & charts (qualitative)
 - Enable data zoom-in (detachable chart, axes zoom, table click)
- Sorting, filtering & searching in data tables
 - **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...

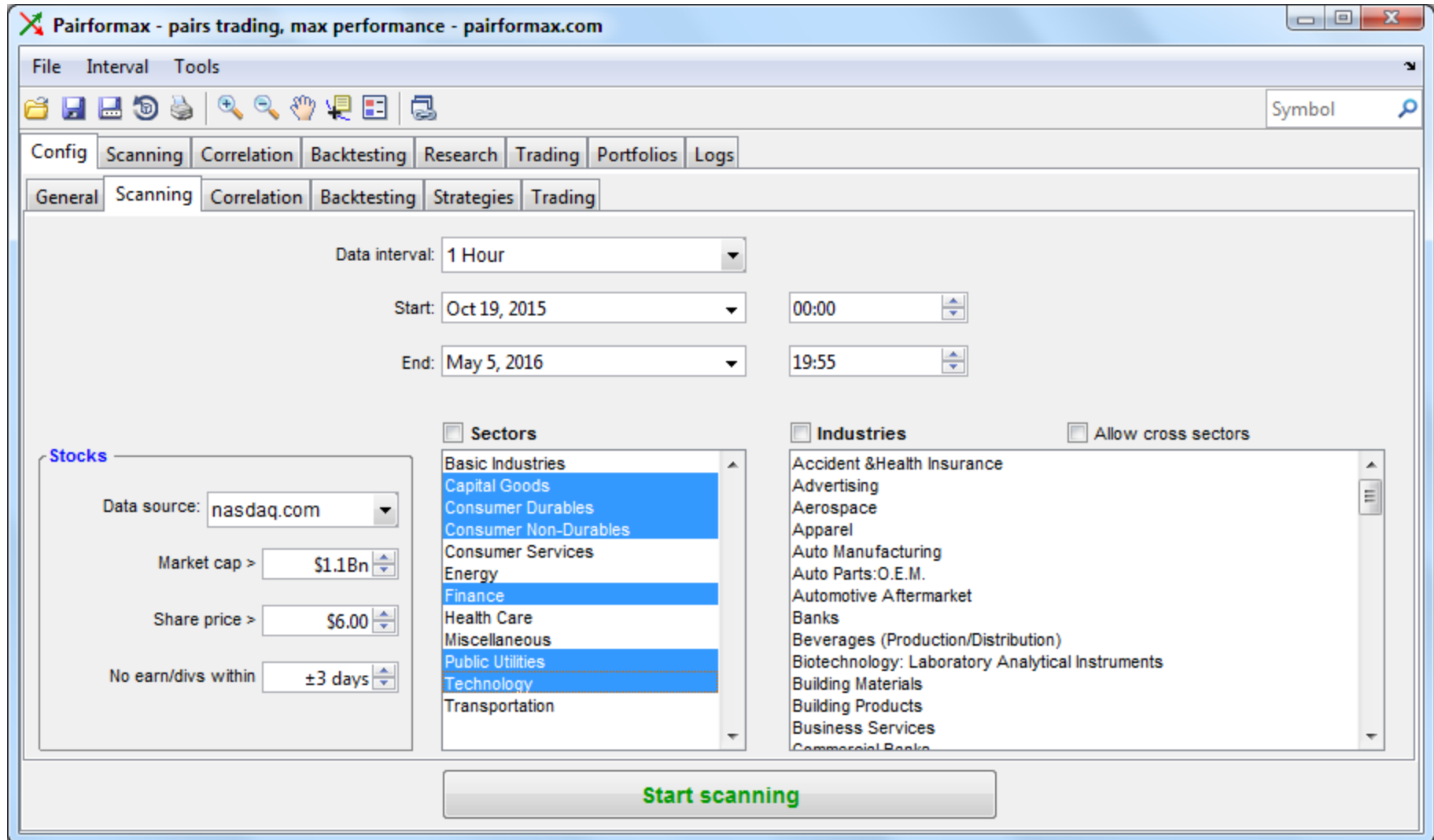
- Improved GUI functionality requires Java controls
- Using Java controls in MATLAB is:
 - Free & super-easy, but:
 - Undocumented
 - Unsupported
 - May break in some future MATLAB release
- Use such features if you:
 - Accept the risk that MathWorks will not fix bugs
 - Are willing to code without MathWorks' 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. The "Config" tab is active, and within it, the "Trading" sub-tab is selected. The main area shows a strategy configuration for "test strategy".

Strategy Configuration:

- Name:** test strategy
- Overview:** Entry A, TP A, SL A, Entry B, TP B, SL B
- 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:**

At the bottom of the interface, there is a large green button labeled "Rerun backtest".

Pairformax screenshots + live demo

Pairformax - pairs trading, max performance - pairformax.com

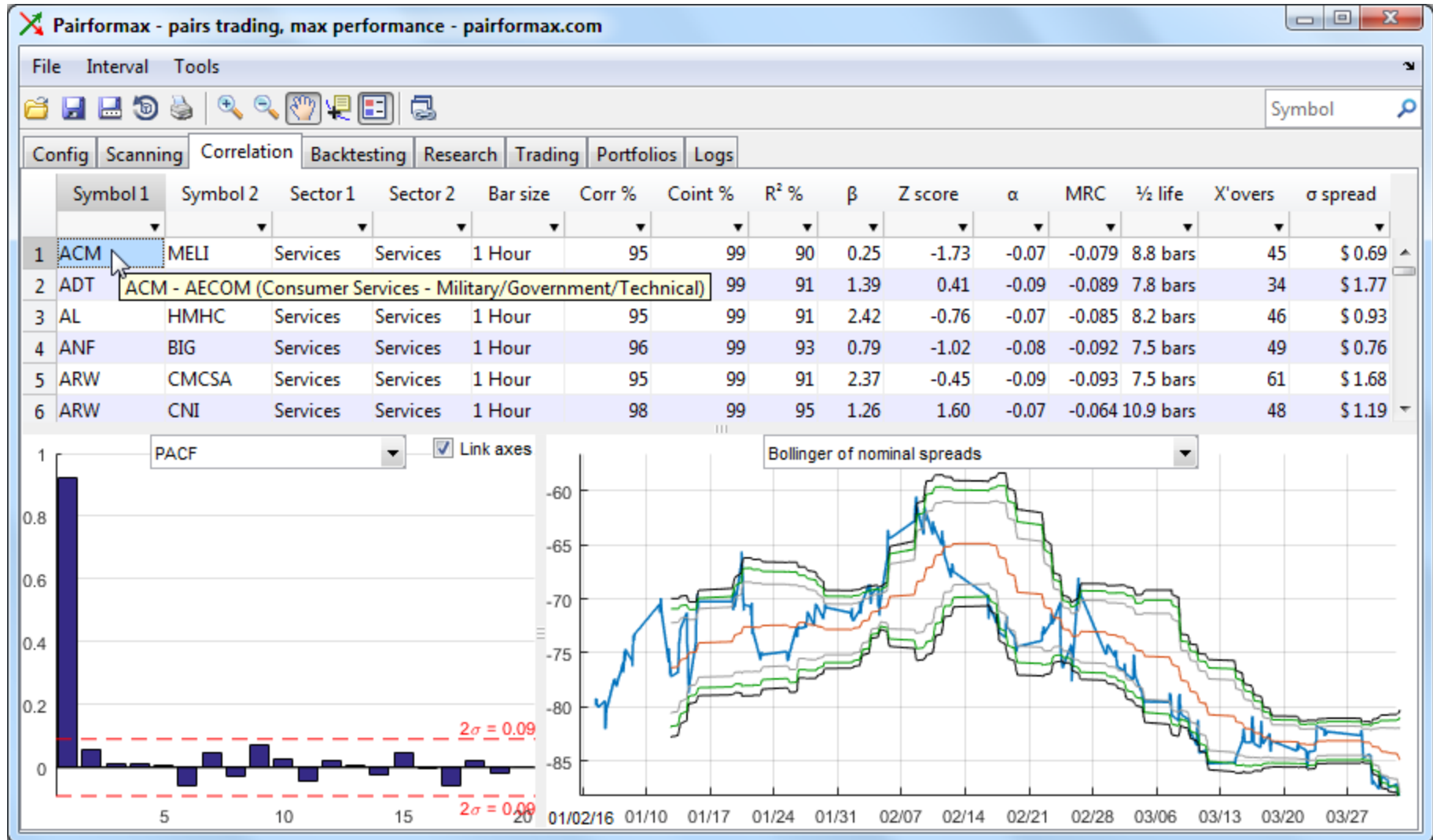
File Interval Tools

Symbol

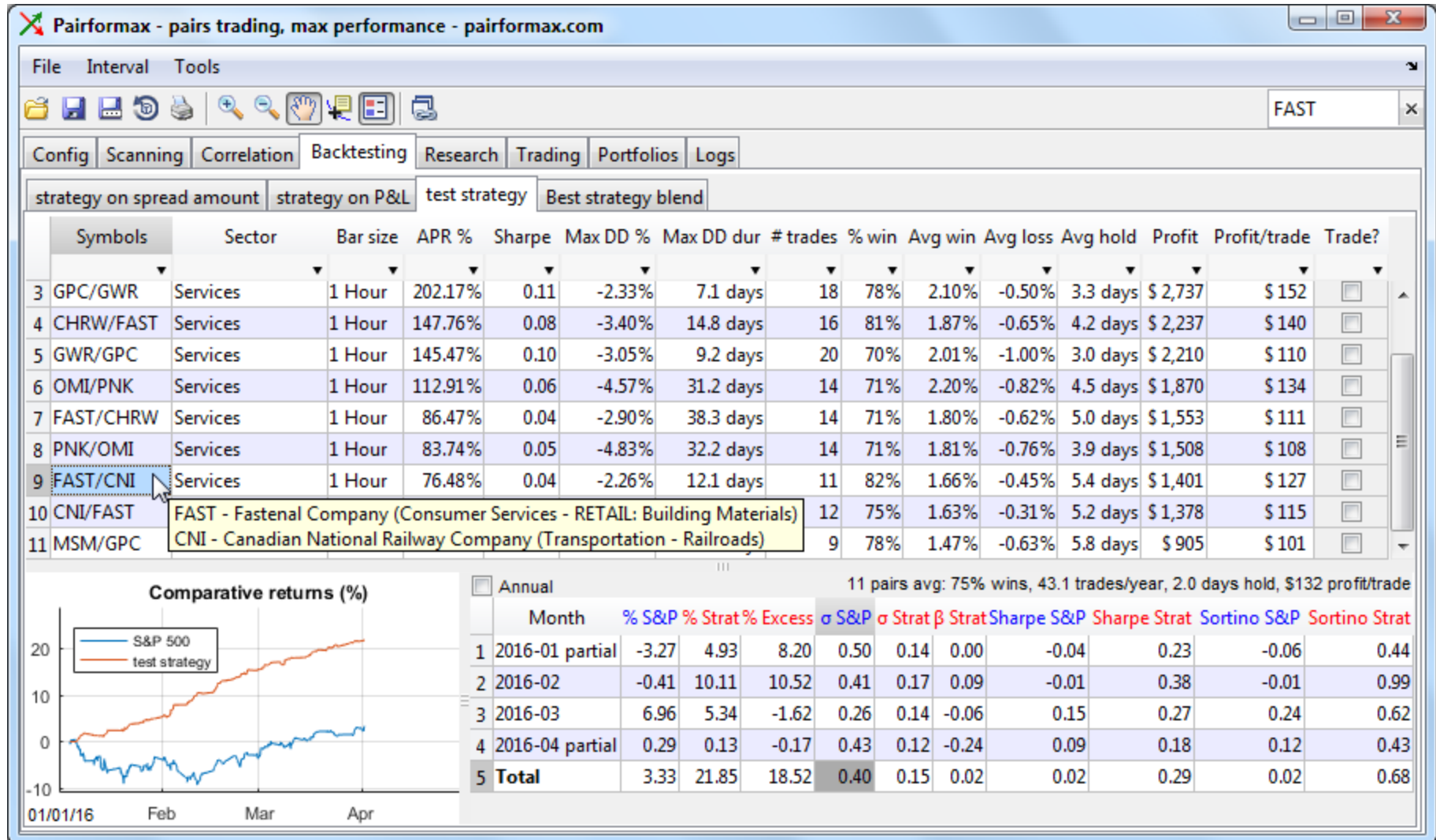
Config Scanning Correlation Backtesting Research Trading Portfolios Logs

	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

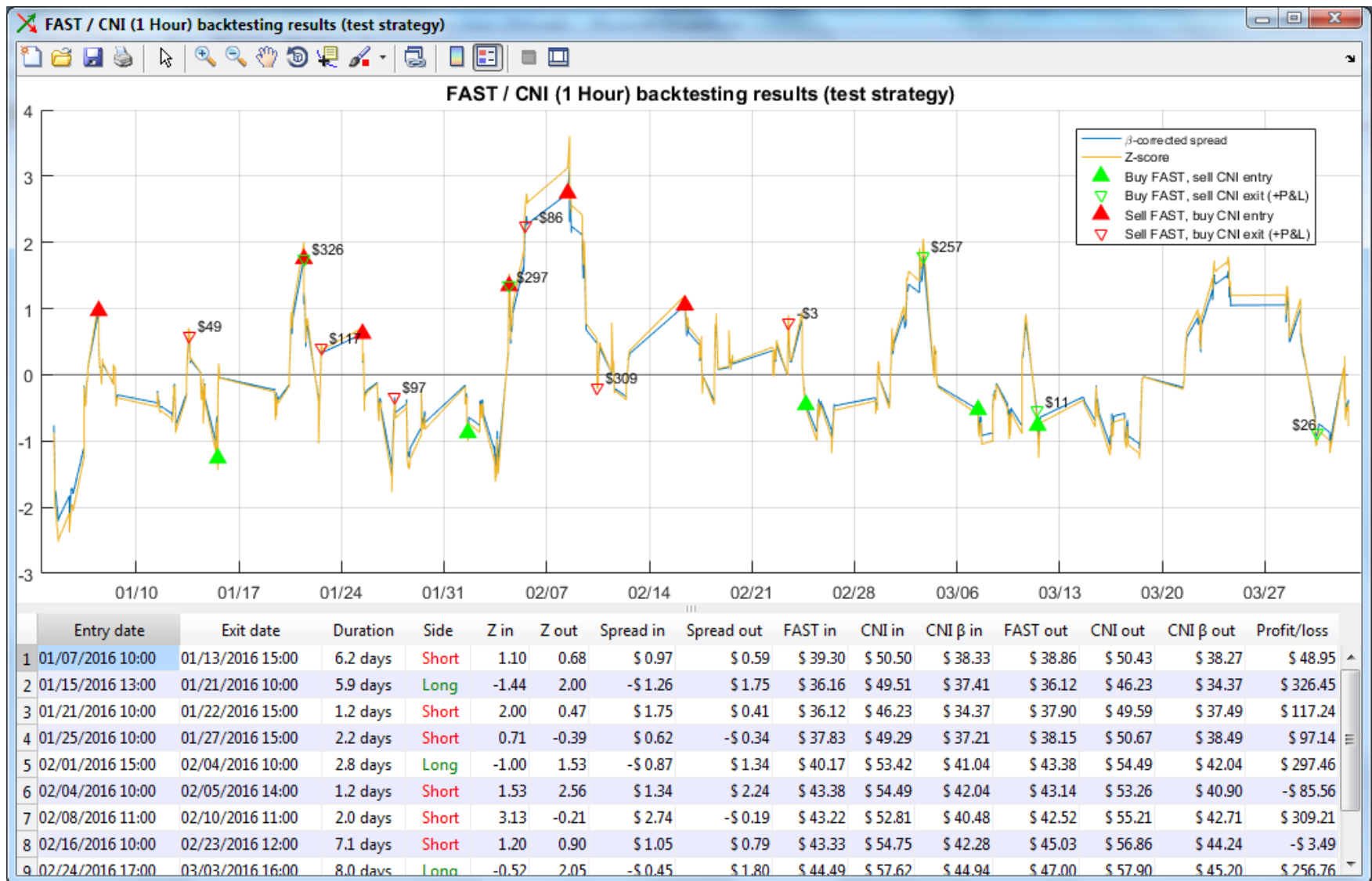
Pairformax screenshots + live demo



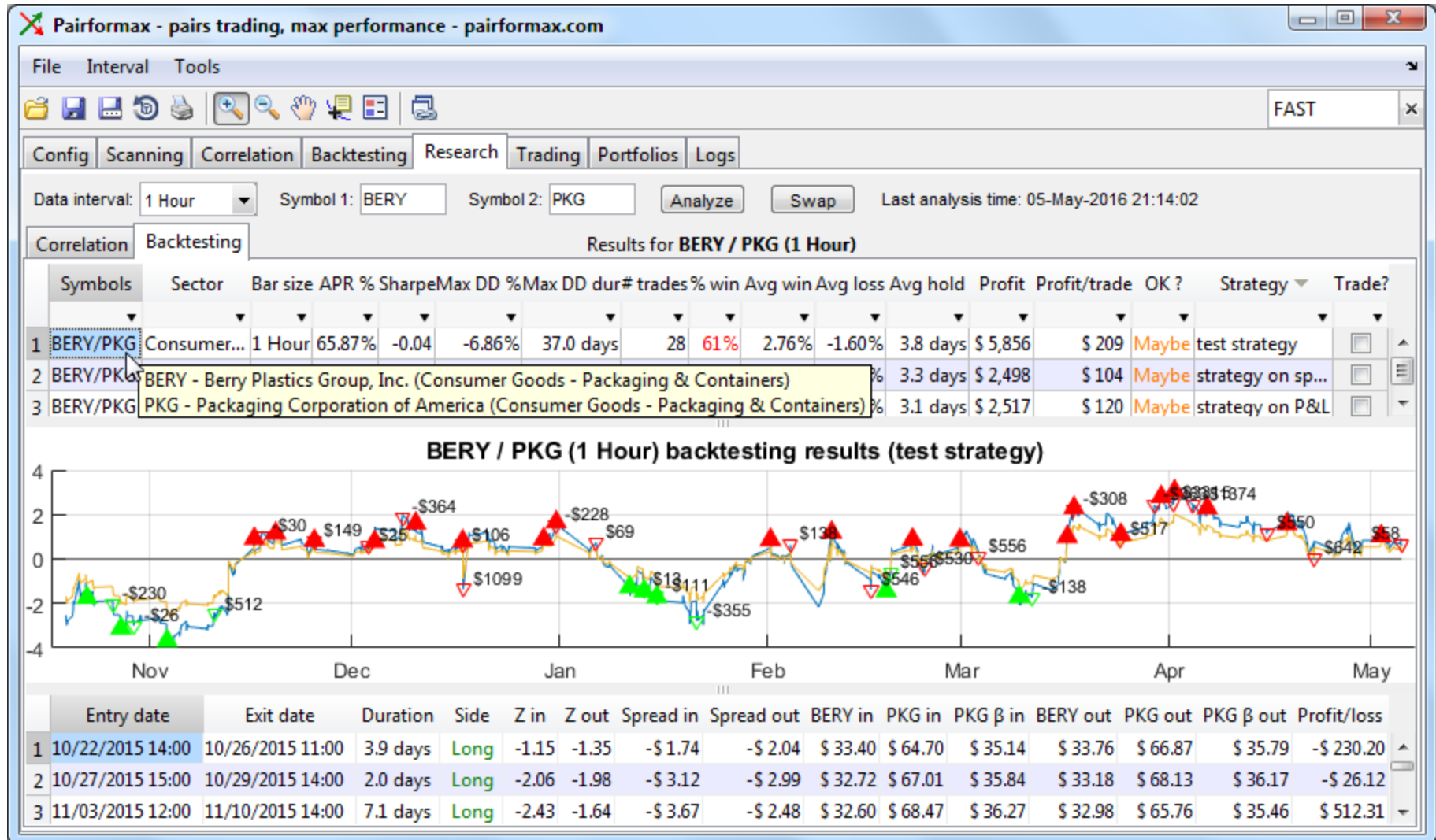
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Pairformax screenshots + live demo

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 ‘ugly’
- 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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