

# Developing professional-quality applications with MATLAB

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Undocumented Matlab.com

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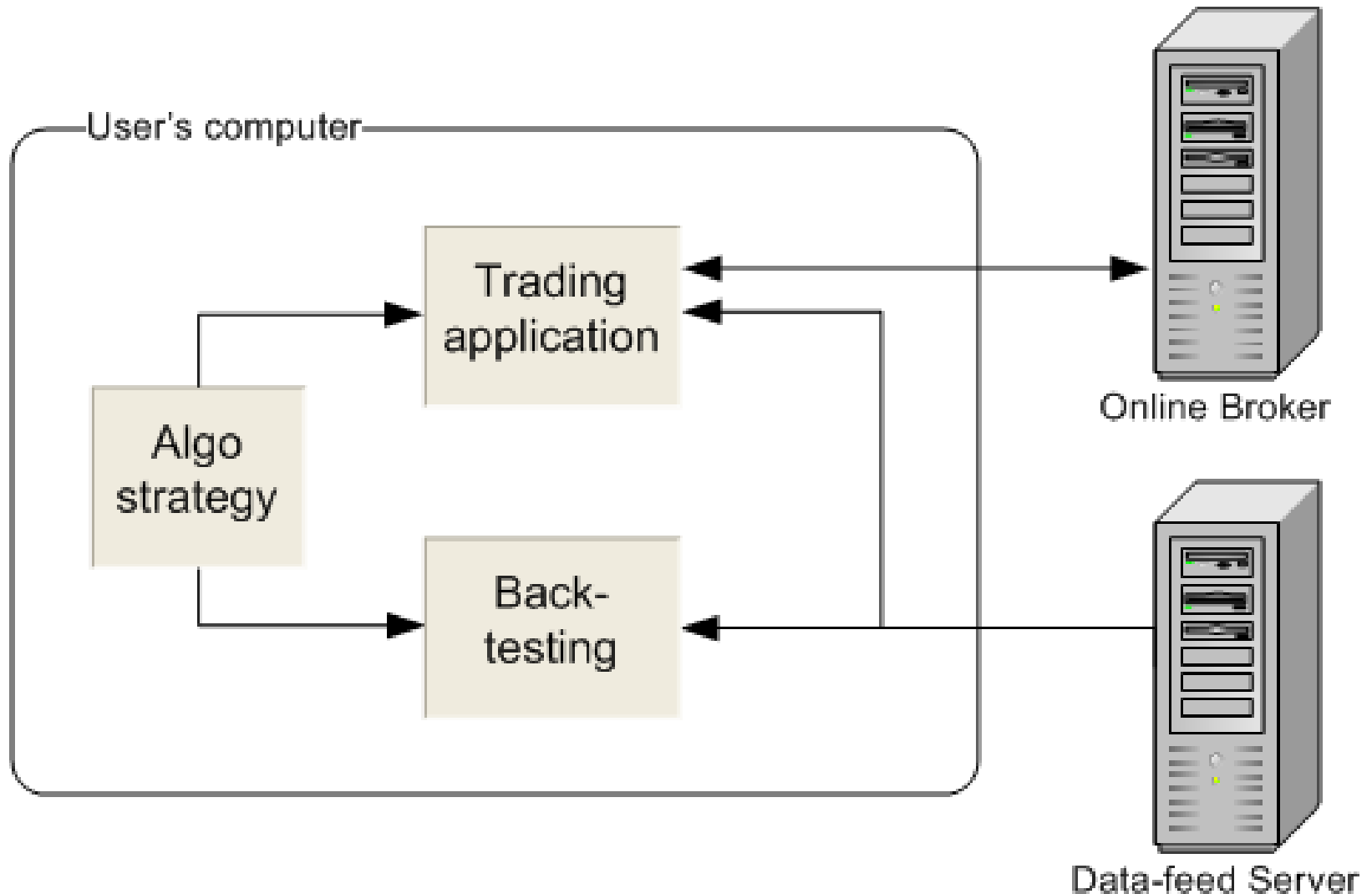


# Common challenges

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

# General trading application design

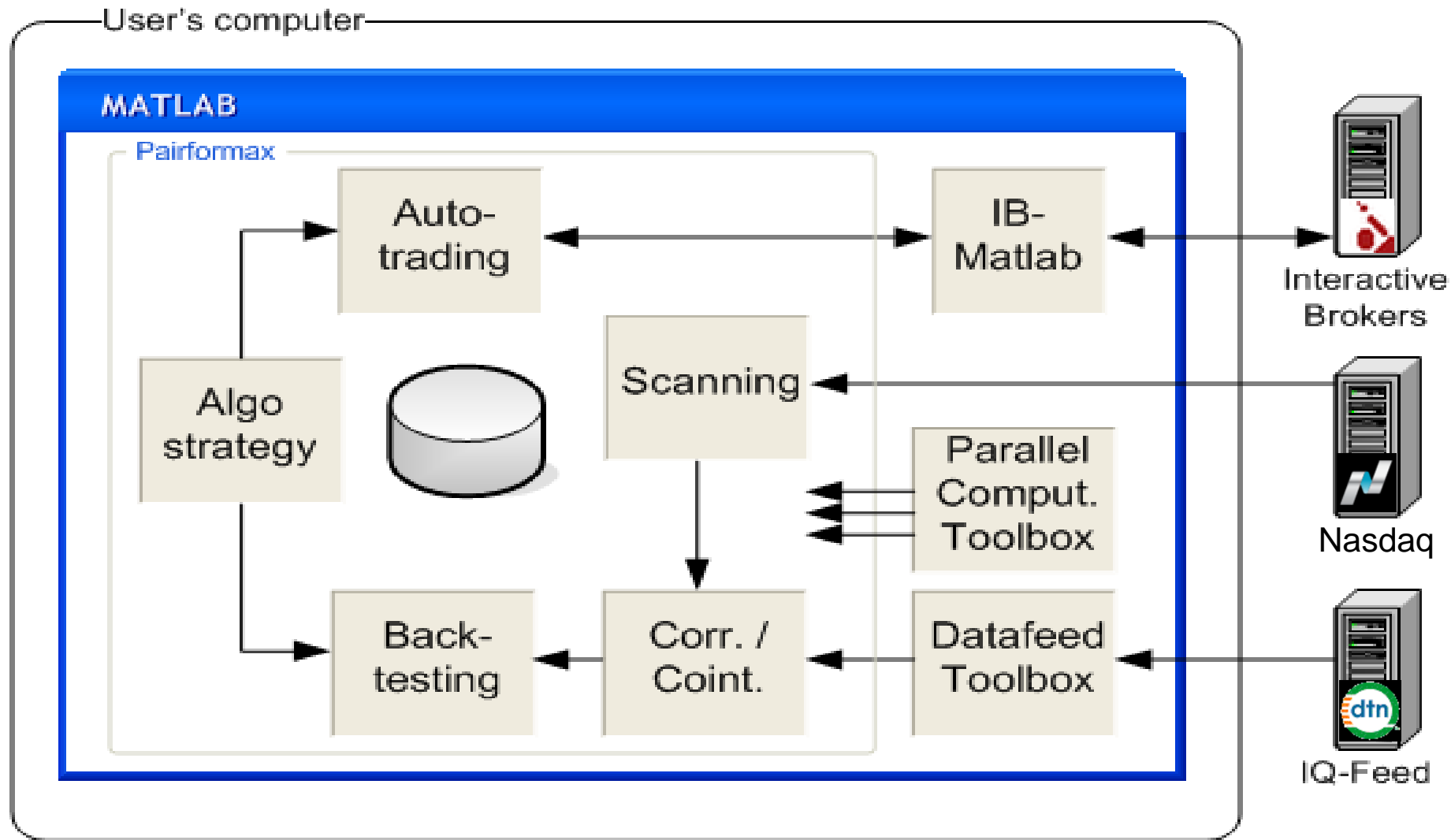


# Pairformax process flow

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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

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- 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

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- 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

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



# Displaying large amounts of data

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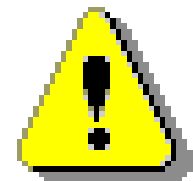
- General concepts
  - Focus user attention on important data (summary, anomalies)
  - Hide less-important data by default
  - Combination of tables (quantitative) & charts (qualitative)
  - Enable data zoom-in (detachable chart, axes zoom, table click)
- Sorting, filtering & searching in data tables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

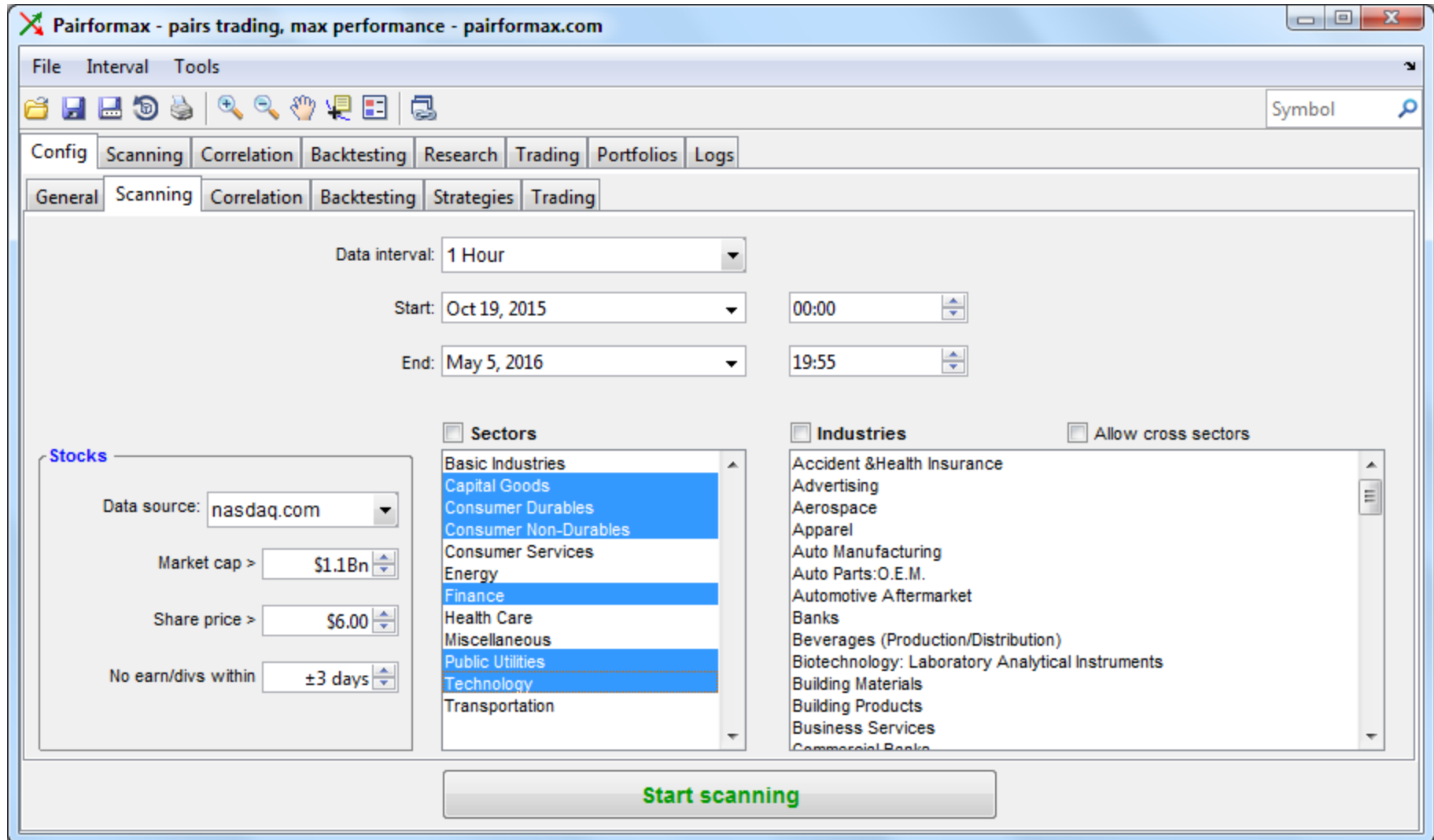


# Improving GUI performance

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- 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 "Strategies" sub-tab is selected. On the left, a list of strategies includes "strategy on spread amount", "strategy on P&L", and "test strategy". The "test strategy" is selected, and its details are shown in the main area. The strategy name is "test strategy". The "Overview" tab is active, 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**

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

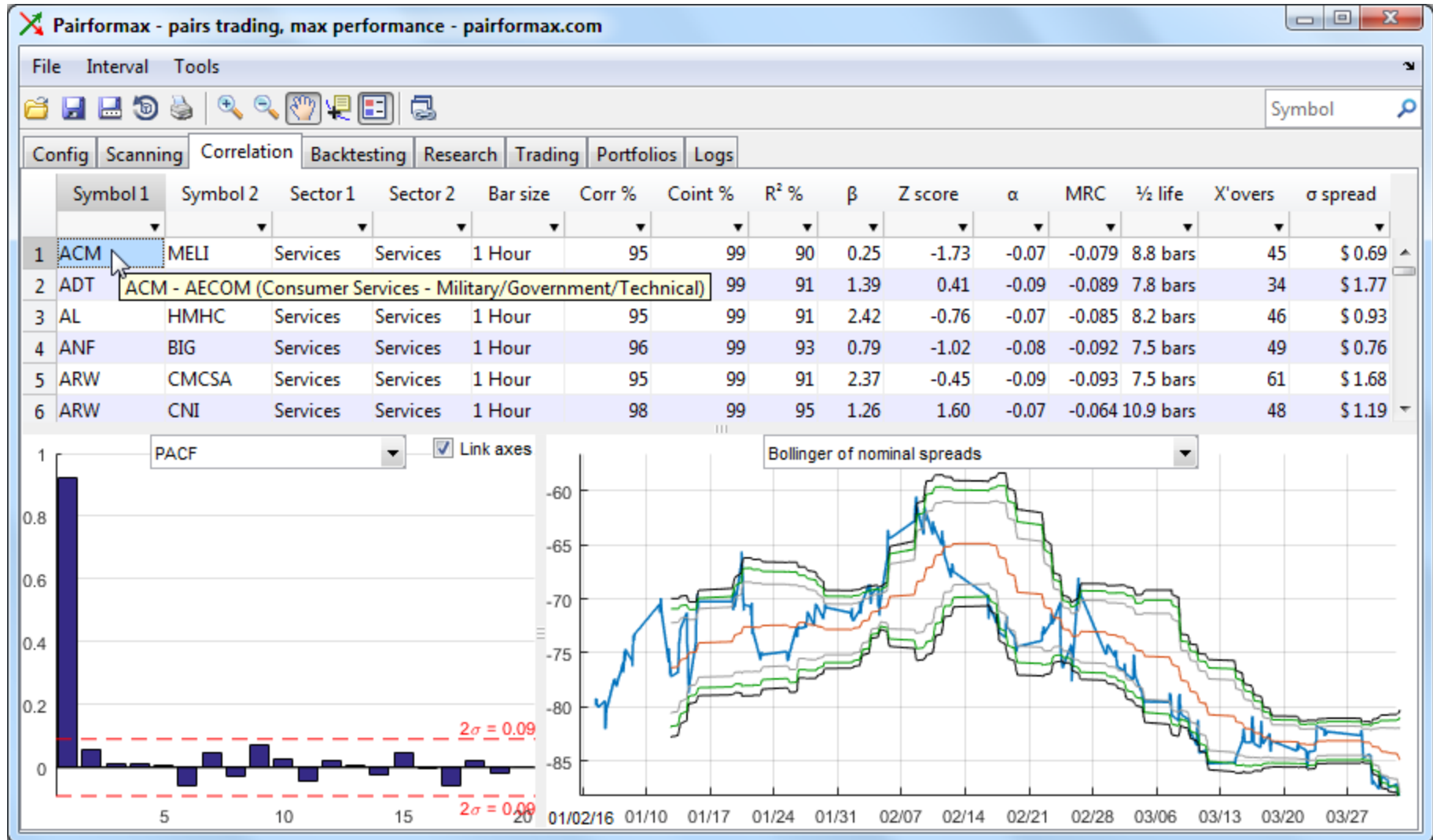
File Interval Tools

Symbol

Config Scanning Correlation Backtesting Research Trading Portfolios Logs

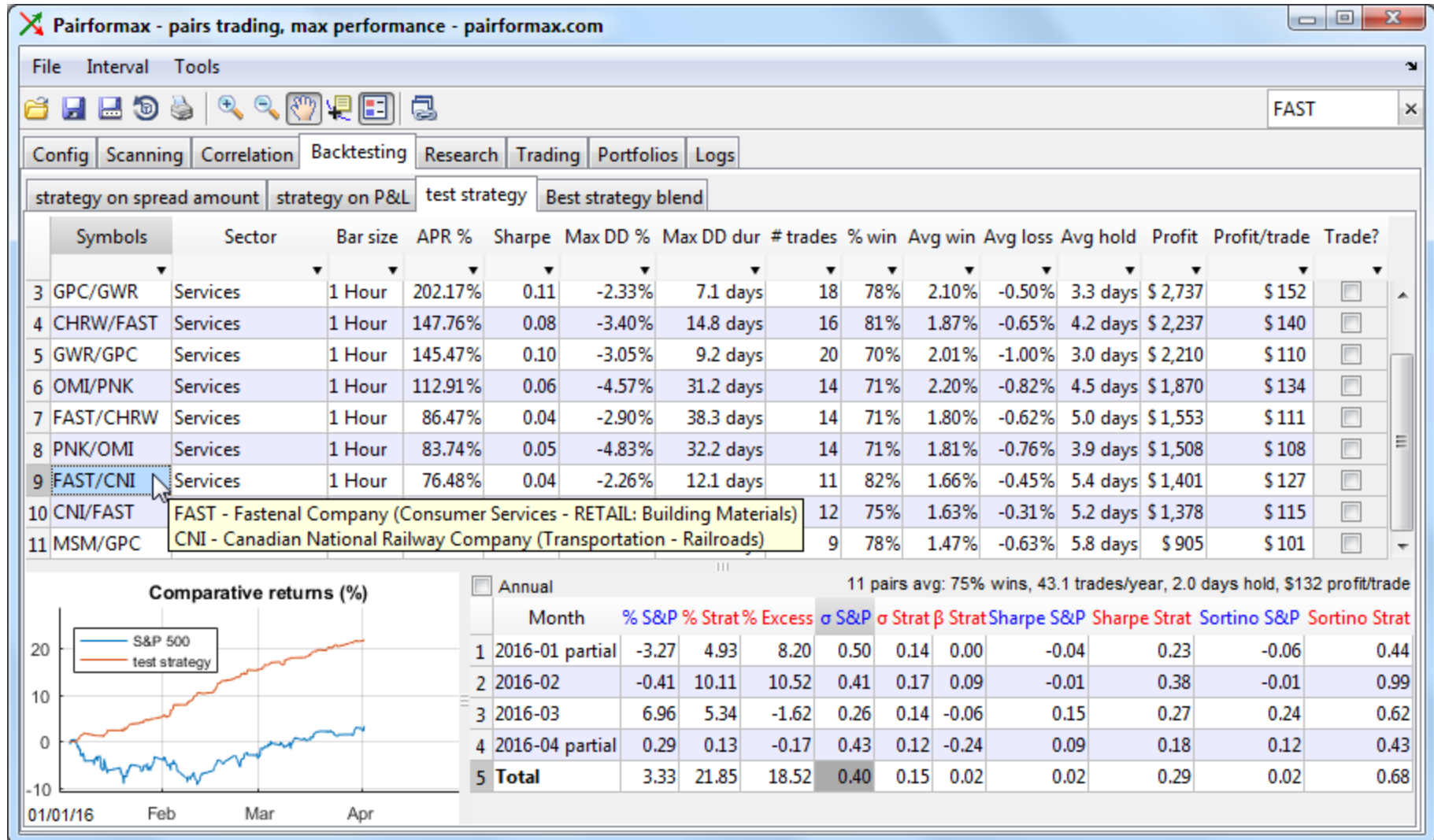
	Sym...	Company	Sector	Industry	Country	Market Cap	P/E	Price	Change	Volume	Next div x date	Next earn date
1	A	Agilent Technologies,...	Healthcare	Medical Laboratories...	USA	\$ 13,366 M	29.4	\$ 40.94	1.04%	493 K	TBA	2016-05-16
2	AAAP	Advanced Accelerator...	Healthcare	Diagnostic Substances	France	\$ 1,375 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

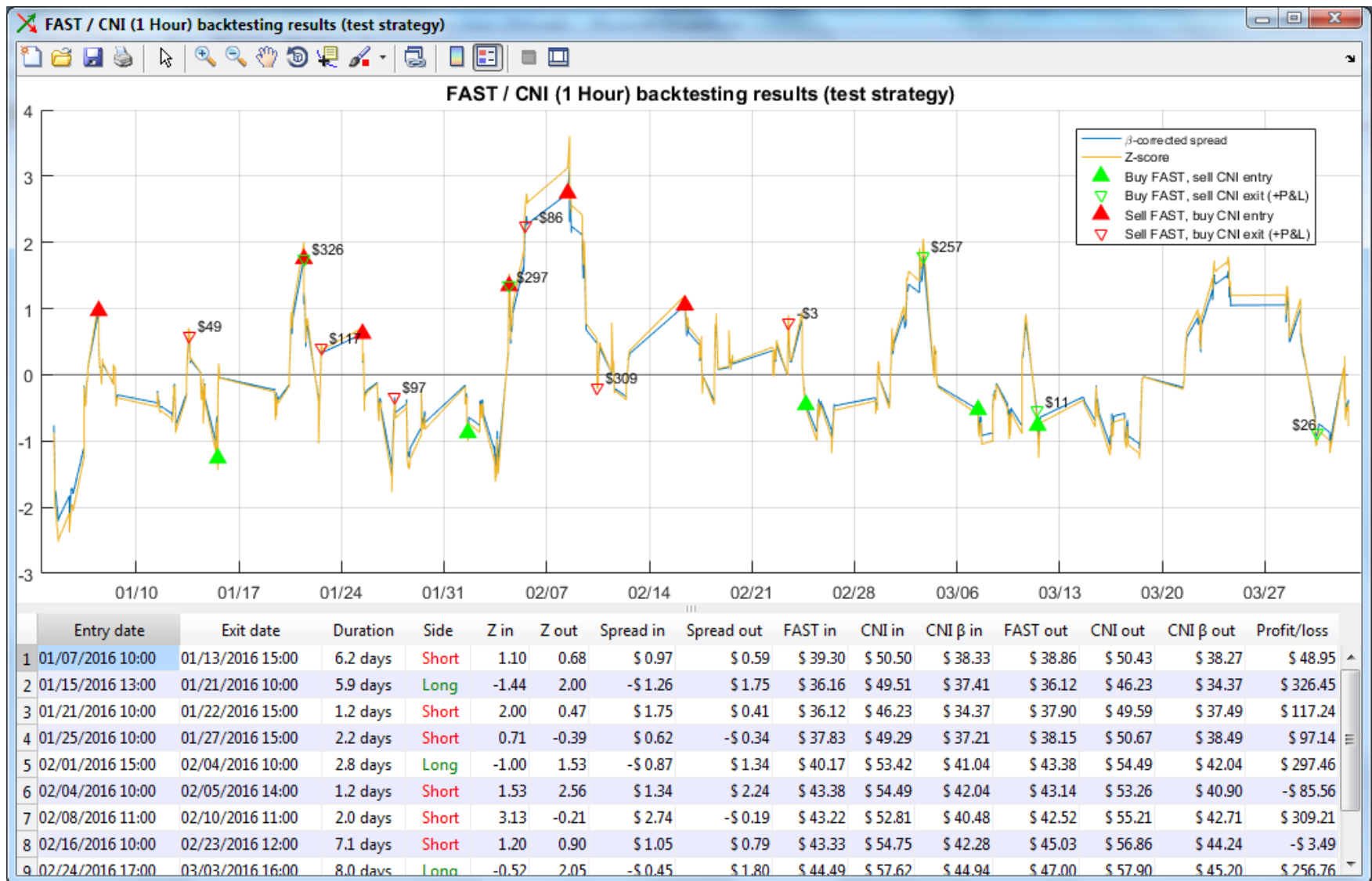




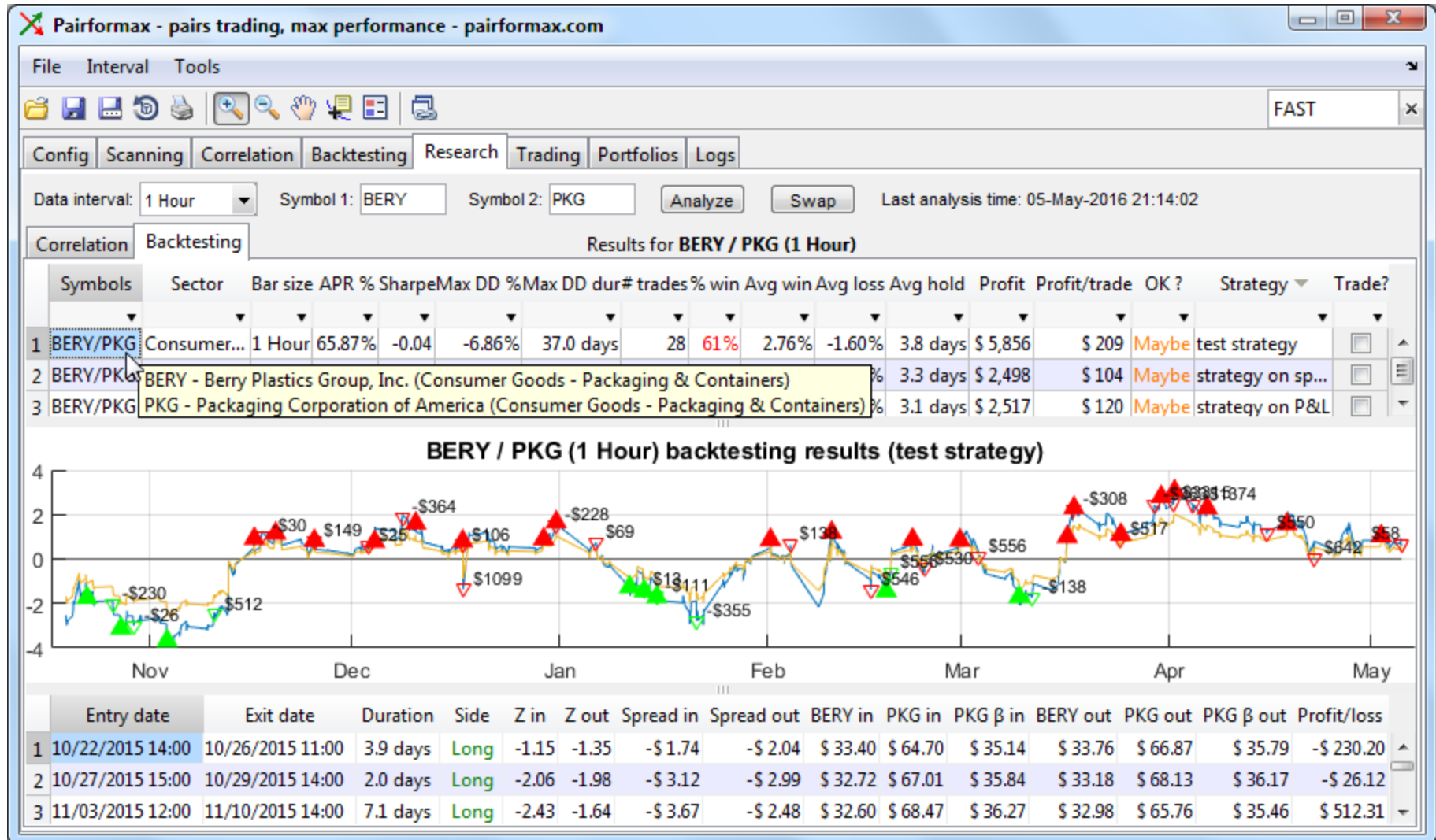
# Pairformax screenshots + live demo



# Pairformax screenshots + live demo



# Pairformax screenshots + live demo



# 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

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

# Conclusions

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- 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

# Thank you!

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

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