

Life Without Matlab

DSP System Design and Analysis on the Cheap

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Why Didn't I Use Matlab?

- Originally, it didn't exist
- **My employer thought it was too expensive to purchase**
- I got used to using other methods
- I got used to using other scripting languages - first Perl, then Python
- I never had much need for it

My Methods

- GUI tools:
 - ScopeDSP – signal analysis
 - ScopeFIR – FIR filter design
 - ScopeIIR – IIR filter design (to be released in Q2 2010)
- C/C++ vector libraries
 - Zero-based
 - Minimal change from design to implementation
- Python
 - General use, built-in support for complex numbers
 - Extensions support vectors and matrices
 - Excellent for data munging
- Excel
 - Tedious, but interactive
 - Good numeric visualization
 - Optimizer works well

GUI Tools for System Design and Analysis

- Tools
 - ScopeDSP: Time and frequency data plotting and analysis of data in files
 - ScopeFIR: FIR filter design and analysis
 - ScopeIIR: IIR filter design and analysis
- Benefits
 - Inexpensive compared to Matlab
 - Easy to learn
 - Easy to use for common DSP tasks
 - Visual
 - Interactive

GUI Tool: ScopeDSP

- Plots time and frequency data from files
- Great for A/D converter performance analysis
- Transforms between domains via an arbitrary-N FFT
- Provides spectral statistics
- Provides basic DSP data manipulations like windowing, scaling, zero-stuffing, etc.
- Optimized for interactive use, e.g. zooming

GUI Tool: ScopeFIR

- Designs FIR filters via the Parks-McClellan algorithm and many others
- Designed for easy interactive use:
 - Data visualization via four-panel layout: specifications, coefficients, frequency plot, impulse plot
 - Provides common FIR data manipulations: minimizing NTaps, quantizing, scaling, polyphase extraction, more

C/C++ Vector Libraries for System Simulation and Implementation

- Allow you to write code as statements rather than loops: simpler to test and debug
- Natural for block-based processing, especially if target supports DMA
- Allow development on multiple platforms (PC and target) and allow easy porting to a new platform
- Can simulate your system using the actual implementation code
- May be more/less efficient on the target than explicit loop code depending on the compiler and processor

System Analysis with Excel

- Benefits:
 - Commonly available
 - Provides numeric visualization
 - Interactive
 - Easy optimization
- Drawbacks
 - Setting up formulas is tedious
 - Plotting is primitive, e.g. no mouse zooming

What is Matlab?

- Matlab is a *system* consisting of:
 - A scripting language which uses complex matrices as the primary data type
 - An extensive set of toyboxes
 - An Integrated Development Environment (IDE) for the above

Advantages of Matlab

- Good IDE
- Large, comprehensive system
 - Lots of toyboxes
 - Related systems like Simulink
- “It’s the standard”
 - You were taught to use it in college
 - You’ve developed your own set of scripts to do common tasks, e.g. plotting a frequency spectrum
 - Your co-workers use it

Problems With Matlab

- High cost
- Hard for beginners to get started with
- Dogmatically a “matrix laboratory”
 - Use of one-based matrices as the fundamental type
 - Poor support for other types, notably strings
 - Use of parens for de-referencing variables (*ick*)
- “Doesn’t do what you expect”

More Problems With Matlab

- Poor design as a scripting language
 - Poor modularization:
 - The only form of modularization is that functions (must) live in their own file
 - No namespacing
 - Poor string handling
 - No hash/dictionary type
 - Object-orientated programming (classes) added only recently
 - One-based
- Emphasis is almost entirely on scripting: GUI elements like “fdatool” are clunky
- That darn schizophrenic semicolon!

What Does Matlab Cost?

- The cost isn't listed on the The Mathworks' web site
- I sent an inquiry via the form on their website but didn't receive a response for weeks
- Finally received a response but repeated emails were needed before they would divulge the price
- Price is in the multi-thousands for Matlab and Signal Processing Toolbox
- Compare to Mathcad, which costs about \$1 100
- Compare to lowegian tools in the low hundreds

Solution to Matlab's High Cost

- Free/open alternatives
 - Matlab-like systems
 - Octave
 - Highly Matlab compatible
 - No IDE
 - Scilab
 - Partially Matlab compatible
 - Includes IDE
 - Provides SciCos as a Simulink replacement
 - Python with SciPy, e.g. “Python(x, y)”
- MathCAD
- Use a mix of free/available/cheap tools like I do

Solution to Matlab's Design

- Use a better scripting language: Python
- Python:
 - Is easy to learn
 - Is general use
 - Supports numeric applications via SciPy (see scipy.org)
 - Has a very clean and simple syntax
 - Has a strong system of modularization
 - Can be embedded and extended

Summary

- Matlab has strengths and weaknesses
- It's perfectly possible to do DSP system design without Matlab
- There are plenty of free/available/cheap alternatives
- No single tool does it all – including Matlab
- Use the tool that best fits the job

A Final Thought

If all you have is Matlab, everything looks like a script.