



Technical Report on

*Literature Review on a Matlab Alternative - Octave*

By Tan Tuan Zea

Advanced Computing Group

27 Feb 2008

This work is licensed under an Attribution-NonCommercial-ShareAlike 2.5 License.  
For more information, please visit the Creative Commons site at  
<http://creativecommons.org/licenses/by-nc-sa/2.5/>

## **Abstract**

Due to the increase in license fee and an effort to cut cost, alternatives to Matlab emerge and are gaining attention among the researcher. More and more researchers have started using these alternatives. More tools are being developed for these alternatives. Octave is one of the promising Matlab replacements. This study seeks to briefly outline the competitive advantage of using Octave.

## Introduction

Matlab is a scientific computational package that provides an expandable environment for mathematical computing and visualization for data analysis. It also provides an intuitive language for development of algorithms and applications. To date, it is estimated that there are 500,000 users worldwide<sup>1</sup> and has more than 600 mathematical, statistical, and engineering functions. However, Matlab is a proprietary software and it is expensive. This has been the main driving motivation for many of the endeavors to develop Matlab alternative. As a result of this high cost, many have turned to Matlab alternative instead. These (open source) alternatives have one additional advantage that their source code is available. This study looks into some of these alternatives. It is found that Octave is one promising tool for Matlab replacement. It is the most compatible Matlab clone, and displayed favorable simulation time<sup>2</sup>. Although the number of packages (toolboxes) is not as complete as Matlab, the number is increasing.

## Alternative

Consequently, there are many endeavors in developing alternative to Matlab, such as the followings:

- ✱ Scilab (<http://www.scilab.org>)
- ✱ Octave (<http://www.gnu.org/software/octave>)
- ✱ JMathLib (<http://www.jmathlib.de>)
- ✱ TeLa (<http://www.geo.fmi.fi/prog/tela.html>)
- ✱ Algae (<http://algae.sourceforge.net>)
- ✱ Lush (<http://lush.sourceforge.net>)
- ✱ Maxima (<http://maxima.sourceforge.net>)
- ✱ Euler (<http://mathsrv.ku-eichstaett.de/MGF/homes/grothmann/euler/index.html>)
- ✱ FreeMat (<http://freemat.sourceforge.net>)
- ✱ Sage (<http://www.sagemath.org>)
- ✱ O-Matrix (<http://www.omatrix.com>)

---

<sup>1</sup> R. Girvan, "MATLAB: The battle for hearts and minds", *Scientific Computing World*. [Available: <http://www.scientific-computing.com/review1.html>, accessed 25 Feb 2008]

<sup>2</sup> J. W. Eaton, "About Octave", Department of Chemical Engineering, University of Wisconsin, 2008. [Available: <http://www.gnu.org/software/octave/about.html>, accessed 27 Feb 2008].

✳ Sysquake (<http://www.calerga.com/products/Sysquake/index.html>)

✳ Maple 11 (<http://www.maplesoft.com/products/Maple11/professionals/index.aspx>)

These alternatives are called Matlab clone sometimes. Matlab clones such as RLab and JMatlab are discontinued from development. Majority of the clone is open source. Most are similar to Matlab in that they are interpreted & matrix-based programming language:

1. Matrix is a fundamental data type.
2. Support for complex numbers is built-in.
3. Math functions and extensive function libraries are built-in.
4. Extensibility in the form of user-defined functions.

## Octave Pros & Cons

Many Matlab alternatives exist and hence, the choice of is non-trivial. These Matlab alternatives differ in terms of cost, number of toolboxes available, quality of interface, quality of support, availability on different platforms, and performance. These qualities can be used as an assay for the Matlab alternatives.

Not all the Matlab alternatives are free. O-Matrix (price ≈S\$864), Maple 11 (price ≈ S\$2463), and Sysquake (price ≈S\$3349) are Matlab clones that are similar to Matlab but with improvement in terms of speed, graphical interface, performance and so on. Which alternatives to choose are highly dependent on the users' needs. As for general research purpose, Octave, an open source data analysis tool, is one of the promising alternatives for Matlab. Open source is an attractive choice as it offers good cost performance ratio. Among all, Scilab and Octave are two mature and high quality clones of Matlab.

Scilab has excellent documentation and support. It is best for window users. Unfortunately, it is not completely compatible with Matlab as the Scilab uses its own language<sup>3</sup>. Octave on the hand has higher compatibility with Matlab and it works better in UNIX. Thus, as most of the high performance computing servers are running on UNIX operating system, Octave in that sense may be a better option if parallel programming is essential.

---

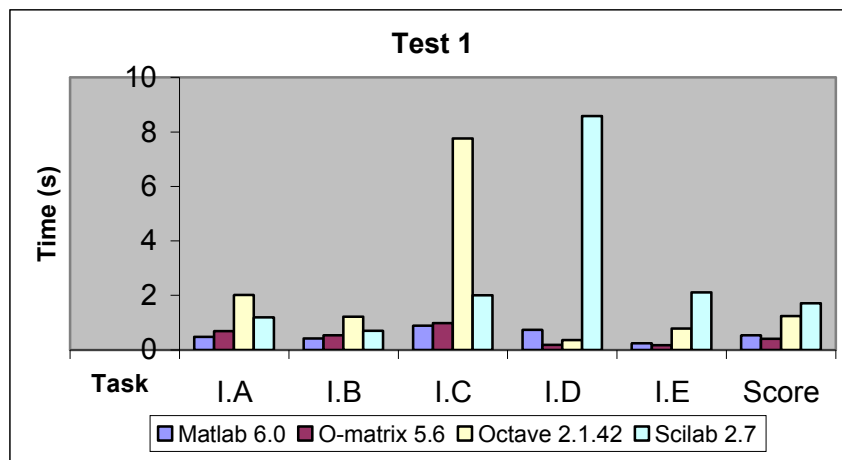
<sup>3</sup> L. T. Dechevsky, A. Laksa, "Brief report on Matlab", TD/285/04/03, COST285, Modelling and simulation tools for research in emerging multi-service telecommunications, 2007.

Computational speed is paramount in choosing data analysis and is the bottleneck for most software application. The computational speed benchmark test results can be obtained from <http://www.sciview.org/benchmark/index.html>. This test was conducted in 2003 on Matlab 6, O-Matrix 5.6, Octave 2.1.42 and Scilab 2.7. At the point of writing, the latest versions of the tools are Matlab 7.5, O-Matrix 6.1, Octave 3.0.0, and Scilab 4.1.2. An extract of the test is given in Table 1.

**Table 1: Benchmark test.**

| Test               |    | Description   |
|--------------------|----|---|
| Matrix Calculation | 1A | Creation, transposition, deformation of 1500x1500 matrix.   |
|                    | 1B | Creation of a 800x800 normally distributed random matrix and taking the 1000 <sup>th</sup> power of all its elements. |
|                    | 1C | Sorting of 2,000,000 random values.   |
|                    | 1D | 700x700 cross-product matrix.   |
|                    | 1E | Linear regression over a 600x600 matrix.  |
| Matrix Function    | 2A | Fast Fourier transform over 800,000 values.   |
|                    | 2B | Eigenvalues of a 320x320 random matrix.   |
|                    | 2C | Determinant of a 650x650 random matrix.   |
|                    | 2D | Cholesky decomposition of a 900x900 matrix  |
|                    | 2E | Inverse of a 400x400 random matrix.   |
| Programming        | 3A | 750,000 Fibonacci numbers calculation.  |
|                    | 3B | Creation of a 2250x2250 Hilbert matrix.   |
|                    | 3C | Grand common divisors of 70,000 pairs.  |
|                    | 3D | Creation of a 220x220 Toeplitz matrix.  |
|                    | 3E | Escoufier's method on a 37x37 random matrix.  |

The tests were run three times on a Pentium IV 1.6 GHz computer with 1 Gb RAM. The system is using window XP professional. The averaged results are summarized in Figures 1 – 3.



**Figure 1: Test 1 performance.**

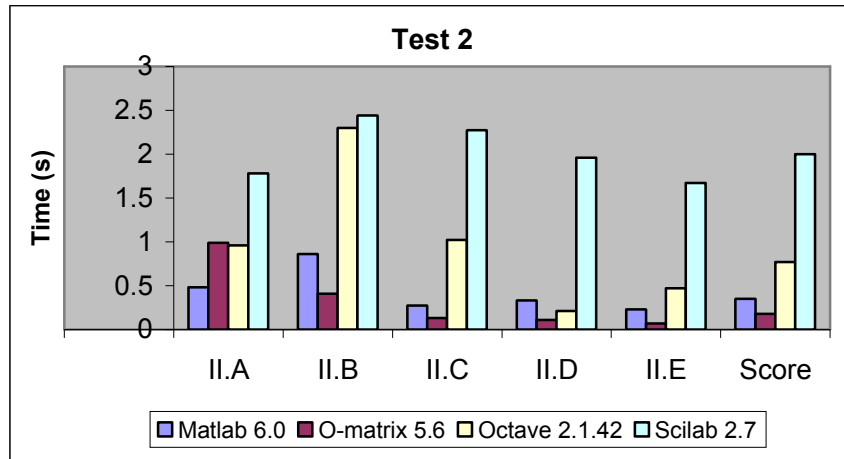


Figure 2: Performance on test 2.

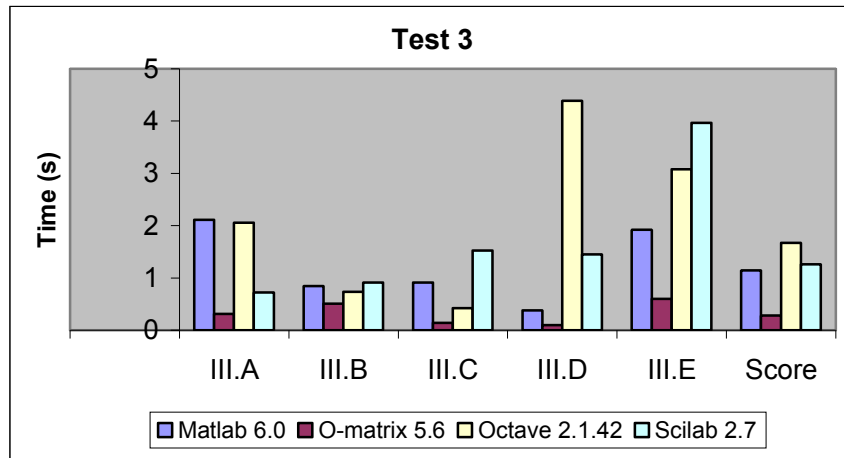


Figure 3: Performance on test 3.

The lower the result is, the faster is the test execution. From Figures 1 – 3, it is shown that O-Matrix has the lowest computational time requirement. Matlab comes second in terms of computational time performance. However, O-Matrix does not have the same range of specialized toolboxes as compared to Matlab, even though it is less expensive. Octave and Scilab are slower in execution time. This could be due to the test is run on window operating system, as Octave runs under the Cygwin emulation of Unix in window. The execution time for Octave might improve if the tests were run on Unix system. Yet, Octave is still faster than Scilab. Although Scilab has more toolbox packages than Octave, Octave outperforms Scilab in computational time requirement.

Furthermore, Octave is highly compatible to Matlab and minimal effort is required to port from Matlab to Octave, many developers who develop toolboxes for Matlab would also

develop for octave as the migration of code is easy. Some examples are, independent component analysis (<http://www.cis.hut.fi/projects/ica/fastica/index.shtml>), statistical toolbox (<http://www.dpmi.tu-graz.ac.at/schloegl/matlab/NaN/>), Physio toolkit (<http://www.physionet.org/physiotools/matlab/wfdb/>), FLAME (formal linear algebra method environment, <http://www.cs.utexas.edu/~flame/>), distributed parallel toolbox ([http://www.cecm.sfu.ca/~rluke/parallel\\_matlab.html](http://www.cecm.sfu.ca/~rluke/parallel_matlab.html)), and others.

Thus, Octave is a promising data analysis tool in replacement of Matlab. The summary of the comparison is given in Table 2.

**Table 2: Summary of Matlab, Scilab and Octave brief comparison.**

| Criteria           | Matlab   | Scilab   | Octave  |
|--------------------|--|--|---|
| System Requirement | Require high memory and disk space for optimum performance.                        | Function well on system with minimum requirement and has minimum dependencies. | Function well on system with minimum requirement and has minimum dependencies.                    |
| Cost               | Expensive  | Free   | Free  |
| Toolbox            | Rich in functions and toolboxes, more than 600+                                    | Rich in functions and toolboxes.   | Relatively lesser than Matlab and Scilab. No profiler, compiler and debugger. No built-in editor. |
| Interface          | Good graphical user interface.   | Poor graphical user interface.   | Poor graphical user interface. Good shell interface.  |
| Support            | Good. Documentation, technical support group, help, email, forum, newsletter, etc. | Good. Documentation, community, help, email, forum, newsletter, etc.           | Good. Documentation, community, help, email, forum, newsletter, etc.                              |
| Platform           | Support Window, Unix, Linux, and Macintosh.  | Support Window, Unix, Linux, and Macintosh. Work better in Window.             | Support Window, Unix, Linux, and Macintosh. Work better in UNIX.                                  |
| Performance        | Fast.  | Relatively slower than Matlab.   | Relatively slower than Matlab on Window operating System.   |

## Octave Packages

The available Octave packages can be found at <http://octave.sourceforge.net/packages.html>

- ✱ Audio
- ✱ Combinatorics
- ✱ Communications
- ✱ Control
- ✱ Econometrics
- ✱ Fixed point real & complex matrix
- ✱ System identification
- ✱ Image processing
- ✱ Information theory

- ✱ Input Output
- ✱ Irregular sampling analysis
- ✱ Algebra
- ✱ XML authoring
- ✱ Neural network (MLP) & SVM.
- ✱ Gaussian Process Regression
- ✱ Optimization (unconstrained non-linear optimization).
- ✱ Parallel & Multicore
- ✱ Plot
- ✱ Signal processing
- ✱ Communication
- ✱ Statistics
- ✱ Functions
- ✱ Symbolic
- ✱ Time
- ✱ 2D & 3D Graphics (VRML, MSH) – (OpenGL interface)
- ✱ GUI (Zenity)
- ✱ Integration
- ✱ Interface (COM, Java, Unix Shell).
- ✱ Time Series Analysis

## Octave & Matlab differences

Although Octave is the most compatible with Matlab, there are differences between Octave and Matlab. Octave parser is beyond Matlab parser, and hence, the program written in Octave is not backward compatible. Most of the compatibility issues arise because of this difference in parser. In other words, there are some syntax differences in the scripting language, for example, Octave support double quote but not in Matlab. Note that only Octave of version 2.9 and later can read Matlab 7.X .mat files. A complete list of the differences can be found in [http://en.wikibooks.org/wiki/MATLAB\\_Programming/Differences\\_between\\_Octave\\_and\\_MATLAB](http://en.wikibooks.org/wiki/MATLAB_Programming/Differences_between_Octave_and_MATLAB), and <http://wiki.octave.org/wiki.pl?MatlabOctaveCompatibility>.

## Conclusion

Matlab clones emerge as a solution to the high cost of data analysis tool such as Matlab. Among these clones, Octave is the one with best compatibility with Matlab, and is one of the most promising data analysis tools. Octave is free, and is competent in its performance. Apart from that, more and more packages or toolboxes are developed for Octave, and this is

closing the gap of richness in functionality between Matlab and Octave. These motivations indicate that Octave is a promising data analysis tool for research and development.

## **General Information**

### *About Octave*

<http://www.gnu.org/software/octave/about.html>

### *Documentations*

<http://www.gnu.org/software/octave/docs.html>

### *Octave Download*

<http://www.gnu.org/software/octave/download.html>

### *Octave mailing list*

<http://www.gnu.org/software/octave/archive.html>

### *Development & Support*

<http://octave.sourceforge.net/>

### *Matlab Octave difference*

[http://en.wikibooks.org/wiki/MATLAB\\_Programming/Differences\\_between\\_Octave\\_and\\_MATLAB](http://en.wikibooks.org/wiki/MATLAB_Programming/Differences_between_Octave_and_MATLAB)

### *Matlab Octave Compatibility Database*

<http://users.powernet.co.uk/kienzle/octave/matcompat/>