

GNU Octave

- a MATLAB-like Open-Source Scientific Computing

-JMB

Full disclosure:

- Much of the textual content came from the local OpenWebUI AI machine.
 - LLMs: gpt-oss:20b & dolphin-mixtral:8x22b
- Some content came from the World Wide Web of course, and very little from my head ...
- Why do that if I am supposed to know this stuff ?
 - I am a 'lazy programmer' and spend hours figuring out the hard way (i.e. making the local AI work properly) when the quick path might be easier :)
 - See how good the LLMs are in my local AI, being the real reason.
 - Since this worked, creating good (or bad) presentations in the future just got easier !
- Well, how good was the AI ?
 - Wait to hear the presentation & see the live demo ...

What is Octave?

- Free, open-source alternative to MATLAB
- Interpreted programming language for numerical computations
- High compatibility (~95 %) with MATLAB syntax & functions
- BSD-style license – works on Linux, macOS, Windows

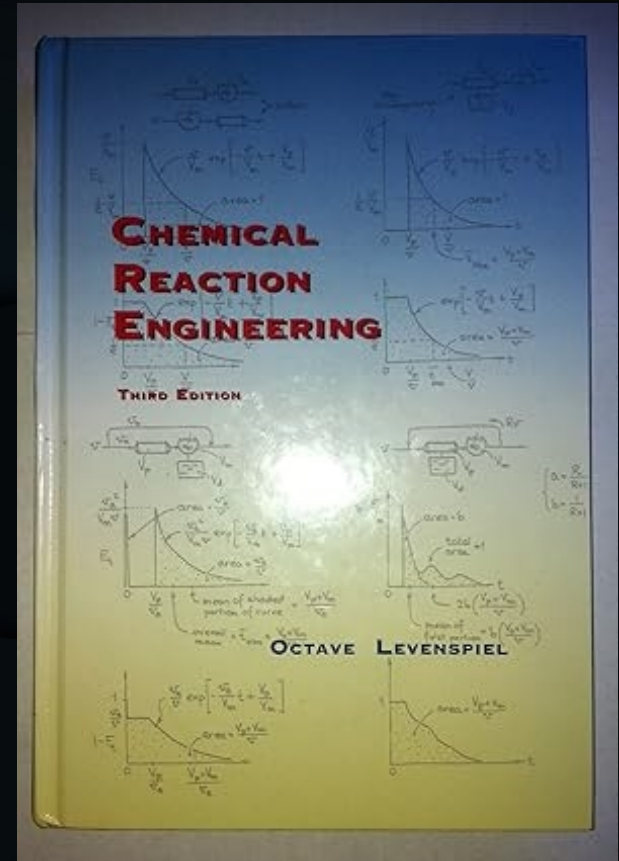
Origins of Octave:

- The project was conceived around 1988. At first it was intended to be a companion to a chemical reactor design course. Full development was started by John W. Eaton in 1992.

https://wiki.octave.org/GNU_Octave_Wiki

- The program is named after Octave Levenspiel, a former professor of the principal author. Levenspiel was known for his ability to perform quick back-of-the-envelope calculations.
- Met John at OctConf 2014 (Montréal, Canada)

https://wiki.octave.org/OctConf_2014



Why Use Octave?

NEED	OCTAVE ADVANTAGE
Cost	Zero license fee
Open-source	Transparent, modifiable, community-driven
Cross-platform	Same code runs on Linux/macOS/Windows
Extensibility	Built-in packages, MATLAB Toolbox compatibility
Education	Ideal for teaching & learning environments

Why did I use Octave?

- As a way to design a better propane burner (RV Refrigerator)
- Verify using Octave the calculations of a dissertation (2008) that laid out the fundamental scientific calculations for optimizing a **gas ejector** and it has the full Matlab source code !

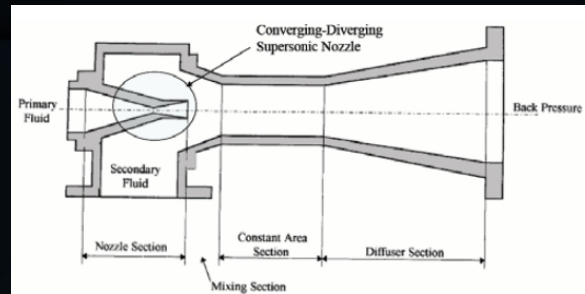


Fig. 1.2 Cross sectional view of a typical gas ejector

GAS EJECTOR MODELING FOR DESIGN AND ANALYSIS

A Dissertation

by

CHAQING LIAO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2008

Major Subject: Nuclear Engineering

Why did I use Octave?

- This dissertation has some **serious** scientific calculations (see pg 37)!
- I wanted to ensure that Octave could reproduce every plot that was in the dissertation.

$$\omega = \frac{P_{s0}}{P_{p0}} \left(\frac{T_{p0}}{T_{s0}} \right)^{\frac{1}{2}} \left(\frac{R_p}{R_s} \right)^{\frac{1}{2}} \left(\frac{\gamma_s}{\gamma_p} \right)^{\frac{1}{2}} \frac{M_{s1}}{M_{p1}} \left(\frac{A_{m3}}{A_t} \frac{1}{f_s(\eta_n, \gamma_p, M_{p1})} - 1 \right) \cdot \frac{\left(1 + \frac{\gamma_s - 1}{2} M_{s1}^2 \right)^{\frac{-(\gamma_s + 1)}{2(\gamma_s - 1)}}}{\left(1 + \frac{\gamma_p - 1}{2} M_{p1}^2 \right)^{\frac{-(\gamma_p + 1)}{2(\gamma_p - 1)}}} \left[\left(\frac{\eta_n - 1}{\eta_n} \right) \frac{\gamma_p - 1}{2} M_{p1}^2 + 1 \right]^{\frac{-\gamma_p}{\gamma_p - 1}} \quad (3.32)$$

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Core Features:

- Interactive command line and GUI (Desktop/Qt)
- Matrix-centric language – vectorized operations
- Extensive built-in mathematical functions
- Plotting utilities (similar to MATLAB's plot, surf, etc.)
- File I/O (text, binary, Excel, HDF5, etc.)
- Support for custom functions, classes (Object Oriented), and packages

Getting Started:

- Debian/Ubuntu: *sudo apt install octave*
- Fedora: *sudo dnf install octave*
- macOS (Homebrew): *brew install octave*
- Windows: download MSI from the official site

Launching:

- octave → Command line
- octave --desktop → GUI

First Script:

- `% hello.m`
- `disp('Hello, Octave!')`
- Run with `octave hello.m`

Basic Syntax –Variables, Operations:

% Create arrays

```
A = [1 2; 3 4];
```

```
x = rand(3,1);
```

% random 3-element column vector

Basic Syntax –Variables, Operations:

% Arithmetic

$B = A + 5;$

% scalar broadcast

$C = A .* x';$

% element-wise multiply

$D = A * x;$

% classic matrix product

Basic Syntax –Variables, Operations:

% Indexing

elem = A(2,1); % element at row 2, column 1

row = A(1,:); % whole first row

col = A(:,2); % whole second column

Flow Control:

% For loop

```
for n = 1:5
```

```
    fprintf('n = %d\n', n);
```

```
end
```

% If-else

```
if det(A) > 0
```

% determinant can be calculated using this formula: $\det \begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc$

```
    disp('Matrix A is positive definite');
```

```
else
```

```
    disp('Matrix A is not positive definite');
```

```
end
```

Plotting -2D:

```
% 2-D line
```

```
x = 0:0.1:2*pi;
```

```
y = sin(x);
```

```
plot(x,y);
```

```
title('Sine Wave'); xlabel('x'); ylabel('sin(x)');
```

Plotting -3D:

```
% 3-D surface
```

```
[X,Y] = meshgrid(-2:0.1:2, -2:0.1:2);
```

```
Z = sin(X).*cos(Y);
```

```
surf(X,Y,Z);
```

```
title('3-D Surface'); xlabel('X'); ylabel('Y');
```

Packages & Toolboxes:

Octave Forge: community-maintained extensions (statistics, signal, bio-informatics, etc.)

Install via: `pkg install -forge <package>`

(I did not use this method, used '`sudo apt install ...`')

MATLAB Compatibility: many MATLAB files load “out of the box”

For MATLAB-specific toolboxes → use MATLAB® packages or copy scripts.

Packages & Toolboxes:

```
sudo aptitude install octave octave-doc
```

```
sudo aptitude install octave-control octave-instrument-control octave-io octave-signal octave-  
data-smoothing octave-sockets
```

```
sudo aptitude install octave-financial
```

```
sudo aptitude install octave-general octave-strings
```

```
sudo aptitude install octave-geometry octave-struct octave-symbolic octave-matgeom
```

```
sudo aptitude install octave-video octave-image octave-image-acquisition
```

```
sudo aptitude install octave-optim octave-statistics
```

Not available anymore: **octave-specfun octave-zenity octave-missing-functions octave-odepkg**

(Some functions of the original odepkg have been transferred to core Octave)

References:

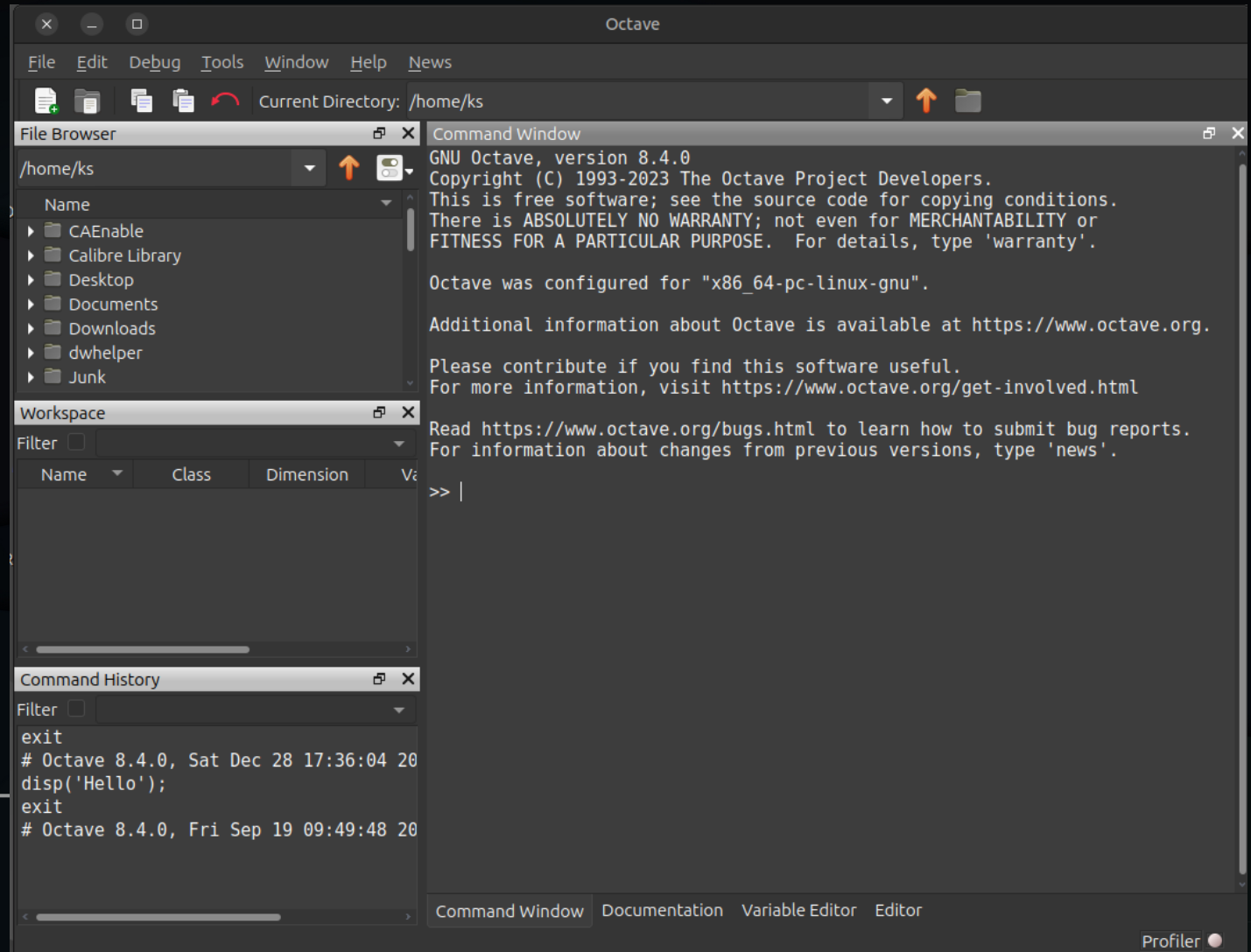
- <https://jweaton.org> jwe@jweaton.org

I'm the original author and primary maintainer of GNU Octave, a full-featured interactive system for numerical computations with hundreds of thousands of users worldwide. I currently work to improve Octave and coordinate the activities of the increasingly active and diverse group of volunteers developing Octave.

- <https://lists.gnu.org/mailman/listinfo/help-octave>
- https://wiki.octave.org/GNU_Octave_Wiki
- <https://octave.sourceforge.io/control/overview.html>
- <https://octave.sourceforge.io/control/function/@iddata/fft.html>
- <https://octave.sourceforge.io/symbolic/function/@sym/laplace.html>

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Live Demo



Questions, comments or rewards:

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