A Tutorial Introduction to Maxima

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Outline

What is Maxima?

(From the website) Maxima is a system for the **manipulation of symbolic and numerical expressions**, *including differentiation, integration, Taylor series, Laplace transforms, ordinary differential equations, systems of linear equations, polynomials, sets, lists, vectors, matrices and tensors.*

What is Maxima?

- Powerful Computer Algebra System (CAS) combining symbolic, numerical, and graphical capabilities

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- ▶ Completely Free and Open Source Software, written in LISP
- ▶ Fully customizable and extensible

Interface

maxima Native CLI

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xmaxima History :)

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xmaxima History :)

wxmaxima Wxwidgets

Interface

maxima Native CLI
xmaxima History :)
wxmaxima Wxwidgets
imaxima Emacs!

Interface

maxima Native CLI

xmaxima History :)

wxmaxima Wxwidgets

imaxima Emacs!

Maxima Init File

- By default, the variable "maxima_userdir" stores the user directory (in Linux it is /.maxima")
- You will have to create this directory and a file "maxima-init.mac" inside it
- Try adding "disp("Greetings!")\$" in the file and fire up maxima

Command Summary

disp display string to stdout

describe,? describe maxima command or variable

apropos,?? inexact search for maxima command or variable

Outline

Some basics

- Statements terminated by a ";"
- Suppress output by terminating with a $
- Variable assignment with ":"
- Function declaration with ":="
- Note: "=" is a symbol, not an operator!
- Lists indices go as 1,2,3,...
- "nouns" and "verbs"

Some basics

Maxima

```
diff(sin(x^2),x);
```

Maxima

```
integrate(cos(x)*cosh(x),x);
```

$$2\,x\,\cos x^2$$

$$\frac{e^{-x}\left(\left(e^{2\,x}-1\right)\cos x+\left(e^{2\,x}+1\right)\sin x\right)}{4}$$

Basic Arithmetic

Handling literals

Maxima

```
(1/2+sqrt(2/3))^2;
```

Maxima

```
expand((1/2+sqrt(2/3))^2);
```

$$\left(\frac{1}{2} + \frac{\sqrt{2}}{\sqrt{3}}\right)^2$$

$$\frac{\sqrt{2}}{\sqrt{3}} + \frac{11}{12}$$

Basic Arithmetic

Handling literals

Maxima

```
expand((1/2+sqrt(2/3))^2),
numer;
```

———————

Maxima

```
fpprec:20;
bfloat(expand(
(1/2+sqrt(2/3))^2));
```

———————

1.733163247594392

$1.7331632475943926994B0$

Algebra

Handling Symbolics

```
expand((x+3*y+x^2*y)^3);
```

```
(x+3*y+x^2*y)^3;
```

$$\left(x + 3\,y + x^2\,y\right)^3$$

$$x^6\,y^3 + 9\,x^4\,y^3 + 27\,x^2\,y^3$$
$$+\,27\,y^3 + 3\,x^5\,y^2$$
$$+\,18\,x^3\,y^2 + 27\,x\,y^2$$
$$+\,3\,x^4\,y + 9\,x^2\,y + x^3$$

Algebra

Handling Symbolics

```
Maxima
expand(subst([x=5/y],
(x+3*y+x^2*y)^3));
```

```
Maxima
factor(27*y^3+810*y+8100/y
+2700/y^3);
```

$$27\,y^3 + 810\,y + \frac{8100}{y} + \frac{27000}{y^3}$$

$$\frac{27\,(100 + 300\,y^2 + 30\,y^4 + y^6)}{y^3}$$

Algebra

Handling Symbolics

Maxima

```
solve([expand(subst([x=5/y],(x+3*y+x^2*y)^3))=0],y);
```

$$\left[y = -\sqrt{10}\,i, y = \sqrt{10}\,i\right]$$

Algebra

Handling Symbolics

Maxima

```
solve([x+y+z=4,y+z-2*x=5,z=4*x-3*y+t,t+y=z],[x,y,z,t]);
```

$$\left[\left[x = -\frac{1}{3}, y = -\frac{1}{3}, z = \frac{14}{3}, t = 5\right]\right]$$

Algebra

Handling Symbolics

Maxima

```
sum(1/n^2,n,0,N);
```

$$\sum_{n=0}^{N} \frac{1}{n^2}$$

Maxima

```
product(1/n^2,n,1,10);
```

$$\frac{1}{13168189440000}$$

Commands Summary

diff symbolic differentiation

integrate symbolic integrations

numer numerical result

fpprec (variable) set floating point precision

bfloat floating point representation

expand expand expression

factor factor expression

subst substitute for variables

solve solve system

Outline

Plotting functions

Explicit function plotting

```
Maxima
plot2d(sin(x),[x,-\%pi,\%pi]);
plot3d(sin(x+y)*cos(x-y),[x,-\%pi,\%pi],[y,-\%pi,\%pi]);
```

pointer: try adding "wx" as a prefix in wxmaxima
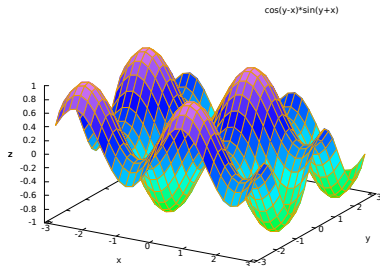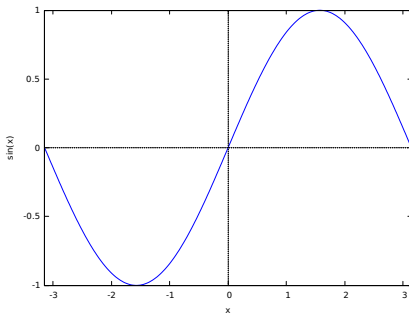
Plotting functions

Implicit plots

```
Maxima
load(implicit_plot);
implicit_plot(x^2=y^2-3*y+1,[x,-4,4],[y,-4,4],
[gnuplot_preamble,"set\ zeroaxis"]);
```
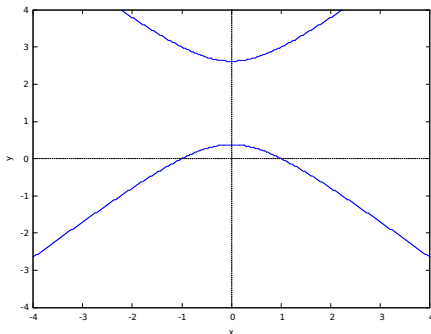
Plotting functions

parametric plots

```
Maxima

r(t):=t;
plot2d([parametric,r(t)*cos(t),r(t)*sin(t),
[t,-2*\%pi,2*\%pi],[nticks,80]],[x,-7,7]);
```
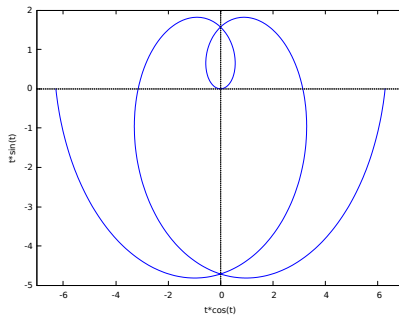
Plotting functions

Maxima

```
expr_1:cos(y)*(12.0+6*cos(x));
expr_2:sin(y)*(12.0+6*cos(x));
expr_3:6*sin(x);
plot3d([expr_1,expr_2,expr_3],
[x,0,2*\%pi],[y,0,2*\%pi],[gnuplot_pm3d,true]);
```

Parametric function
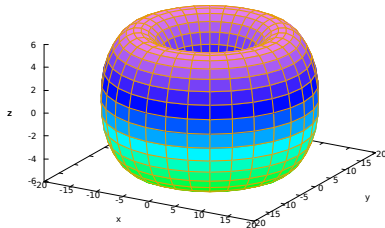
Plotting functions

Misc

Maxima

```
set_plot_option([gnuplot_preamble,"set\ cntrparam
levels\ 12"]);
contour_plot(sin(y)*cos(x)^2,[x,-4,4],[y,-4,4]);
```
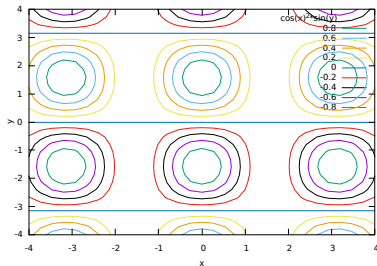
Plotting functions

Discontinuous function

```
g(x):=\ if\ x>=1\ and\ x<2\ then\ (x-1)\ elseif\ x>=2
and\ x<=3\ then\ (6-2*x)\ else\ 0;
```

$$g\left(x\right) := \mathbf{if}\ x \geq 1 \wedge (x \\ < 2)\ \mathbf{then}\ x - 1\ \mathbf{elseif}\ x \\ \geq 2 \wedge (x \\ \leq 3)\ \mathbf{then}\ 6 - 2\,x\ \mathbf{else}\ 0$$

Plotting functions
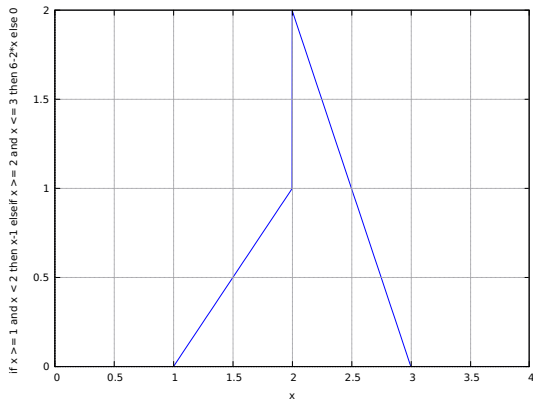
Commands Summary

plot2d 2d plots

plot3d 3d plots

implicit_plot plotting implicit expressions

contour_plot contours

Outline

Systems of equations

Maxima

```
apropos("solve");
```

[baksolve, desolve, funcsolve, globalsolve, linsolve,
  linsolvewarn, linsolve_by_lu, linsolve_params,
  solve, solvedecomposes, solveexplicit, solvefactors,
  solvenullwarn, solveradcan, solvetrigwarn, tmlinsolve]

Systems of equations

linear systems

```
Maxima
eq1:x+y=8*a*x-z+4*5;\ eq2:y+z*\%pi=4*x;
eq3:x-y+z=4;
linsolve([eq1,eq2,eq3],[x,y,z]);
```

$$\left[x = -\frac{8 + 12\,\pi}{(4 + 4\,\pi)\,a - \pi - 4}, y = -\frac{32 + 8\,\pi + 16\,\pi\,a}{(4 + 4\,\pi)\,a - \pi - 4}, \right.$$
$$\left. z = \frac{16\,a - 40}{(4 + 4\,\pi)\,a - \pi - 4} \right]$$

Systems of equations

Algebraic Equation (analytic solution)

Maxima

```
solve(a*x^2+b*x+c=0,x);
```

$$\left[x = -\frac{b + \sqrt{b^2 - 4\,a\,c}}{2\,a}, x = \frac{\sqrt{b^2 - 4\,a\,c} - b}{2\,a} \right]$$

Systems of equations

Substitute values

Maxima

```
sol:solve(a*x^2+b*x+c=0,x);
radcan(subst([a=1,b=2,c=3],sol[1]));
```

$$x = -\sqrt{2}\,i - 1$$

Systems of equations

System of algebraic equations

```
Maxima
f(x):=x^2-1;
solve([f(x/y)=0,f(x*y)=0],[x,y]);
```

$$f\left(x\right) := x^2 - 1$$

$$[[x = -1, y = 1], [x = 1, y = -1], [x = -i,$$
$$y = -i], [x = i, y = i], [x = -i, y = i], [x = i,$$
$$y = -i], [x = -1, y = -1], [x = 1, y = 1]]$$

Systems of equations

Polynomials & Numerical solutions

---Maxima---

```
allroots(x^5+x^2-x+8=0);
```

$[x = 0.9189543576112322\,i + 1.179427901164746,$
$x = 1.179427901164746 - 0.9189543576112322\,i,$
$x = 1.427958893635229\,i - 0.3522627040736663,$
$x = -1.427958893635229\,i - 0.3522627040736663,$
$x = -1.65433039418216]$

Systems of equations

Checking Solution

Maxima

```
f(x):=x^3+x^2-x+8$\ sol:allroots(f(x))$
expand(map(f,sol));
```

$$\Big[x^3 + x^2 - x + 8 = 4.440892098500626$$
$$\times 10^{-16}\,i + 1.77635683940025 \times 10^{-15},$$
$$x^3 + x^2 - x + 8 = 1.77635683940025 \times 10^{-15}$$
$$- 4.440892098500626 \times 10^{-16}\,i, x^3 + x^2 - x + 8 = 0.0\Big]$$

Systems of equations

Maxima

```
load(newton);
newton(x^7-5*x^6+4*x^4-
5*x^2+x+2,0);
```

Maxima

```
newton(x^7-5*x^6+4*x^4-
5*x^2+x+2,1);
```

$-5.763042928902195_B \times 10^{-1}$

$8.194213634964119_B \times 10^{-1}$

Commands Summary

apropos apropos search

linsolve solve linear systems

solve solve algebraic equations

subst substitute values to expressions

allroots numerically estimate all roots of a polynomial

kill "kill(a,b,c);" lets you delete unwanted variables

map map the solutions to a function

Outline

Vectors

Maxima

```
load(vector);
functions;
```

$$[\text{dimension}\,(),\text{type}\,(arg)\,,\text{coordsystem}\,(sys)\,,\text{cross}\,(a,$$
$$b)\,,\text{grad}\,(s)\,,\text{div}\,(v)\,,\text{curl}\,(a)\,,\text{laplacian}\,(a)\,,\text{dotdel}\,(v,$$
$$b)\,,\text{christoffel}\,()\,,\text{curlgrad}\,(s)\,,\text{graddiv}\,(v)\,,\text{divcurl}\,(v)]$$

Vectors

```
Maxima
v1:[x1,y1,z1]$
v2:[x2,y2,z2]$
v1\ cross\ v2;
```

```
Maxima
v1.v2;
```

$$[y1\, z2 - y2\, z1,$$
$$x2\, z1 - x1\, z2, x1\, y2 - x2\, y1]$$

$$z1\, z2 + y1\, y2 + x1\, x2$$

Matrices and Linear Algebra


```
Maxima

load(diag);
A:matrix([a,b,c],[d,e,f],[g,h,i]);
col(A,1);
row(A,2);
invert(A);
transpose(A);
determinant(A);
list_matrix_entries(A);
```

Row major!

Matrices and Linear Algebra

Matrix Products

```
Maxima

load(diag);
A:matrix([a,b,c],[d,e,f],[g,h,i]);
B:transpose(matrix([c,d,e]));
A.B;
A*A;
A^2;
A^^2;
rank(A);
```

Matrices and Linear Algebra

Matrix properties

Maxima

```
A:matrix([1,2],[4,5]);
eigenvectors(A);
```

$$\left[\left[\left[3-2\sqrt{3}, 2\sqrt{3}+3\right], [1,1]\right], \left[\left[\left[1, 1-\sqrt{3}\right]\right], \left[\left[1, \sqrt{3}+1\right]\right]\right]\right]$$

Matrices and Linear Algebra

Other functionality

Maxima

```
load(eigen);
load(linearalgebra);
```

Command Summary

matrix create a matrix

col access column of a matrix

row access row of a matrix

transpose transpose of a matrix

determinant obtain the determinant of a matrix

rank obtain the rank of a matrix

invert invert a matrix

list_matrix_entries list out the matrix in row major

eigenvectors obtain the eigen vectors

Outline

Differential Calculus

Independant variable specified

Maxima

```
diff(x^n,x,2);
```

$$(n-1)\, n\, x^{n-2}$$

Unspecified independant variable

Maxima

```
diff(x^n);
```

$$n\, x^{n-1}\, dx + x^n\, \log x\, dn$$

Differential Calculus

$$\frac{\partial}{\partial \mathbf{y}} \frac{\partial^2}{\partial \mathbf{x^2}} \left(\sin(x) \cos(y - x) \right)$$

```
diff(sin(x)*cos(y-x),x,2,y,1);
```

$$2 \sin x \, \sin (y - x) + 2 \cos x \, \cos (y - x)$$

Differential Calculus

Maxima

```
declare(a,constant);
depends([x,y],t);
diff(x^2+a*y^2,t);
```

$$2\,a\,y\,\left(\frac{d\,y}{d\,t}\right) + 2\,x\,\left(\frac{d\,x}{d\,t}\right)$$

Try out "properties(a);" & "propvars(constant);"

Differential Calculus

Maxima

```
gp:diff(x^(2/3),x);
limit(gp,x,0,plus);
```

$$\frac{2}{3\,x^{\frac{1}{3}}}$$

$$\infty$$

Maxima

```
limit(gp,x,0,minus);
limit(gp,x,0);
```

$$-\infty$$

infinity

Differential Calculus

Maxima

```
dydx(expr,x,y):=
diff(expr,x)/diff(expr,y);
```

Maxima

```
dydx(cos(x^2-y^2),x,y);
```

$$\text{dydx}\left(\text{expr}, x, y\right) := \frac{\text{diff}\left(\text{expr}, x\right)}{\text{diff}\left(\text{expr}, y\right)}$$

$$-\frac{x}{y}$$

Taylor (or Laurent) series

Maxima

```
taylor(f(x),x,0,3);
```

$$f\left(0\right)+\left(\frac{d\,f\left(x\right)}{d\,x}\bigg|_{x=0}\right)x+\frac{\left(\frac{d^2\,f(x)}{d\,x^2}\big|_{x=0}\right)x^2}{2}+\frac{\left(\frac{d^3\,f(x)}{d\,x^3}\big|_{x=0}\right)x^3}{6}+\cdots$$

Taylor (or Laurent) series

Maxima

```
taylor(cos(x),x,0,10);
taylor(sin(x),x,0,10);
```

$$1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \frac{x^8}{40320} - \frac{x^{10}}{3628800} + \cdots$$

$$x - \frac{x^3}{6} + \frac{x^5}{120} - \frac{x^7}{5040} + \frac{x^9}{362880} + \cdots$$

Taylor (or Laurent) series

```
taylor(cos(x+y),[x,y],[0,0],[2,4]);
factor(ratsimp(\%));
```

$$1 - \frac{y^2 + 2\,y\,x + x^2}{2} + \frac{y^4 + 4\,y^3\,x + 6\,y^2\,x^2 + 4\,y\,x^3 + x^4}{24} + \cdots$$

$$\frac{24 - 12\,x^2 + x^4 - 24\,x\,y + 4\,x^3\,y - 12\,y^2 + 6\,x^2\,y^2 + 4\,x\,y^3 + y^4}{24}$$

Taylor (or Laurent) series

Maxima

```
taylor(sin(x+y),[x,0,4],[y,0,4]);
```

$$y - \frac{y^3}{6} + \cdots + \left(\frac{y^4}{24} - \frac{y^2}{2} + 1 + \cdots\right) x + \left(\frac{y^3}{12} - \frac{y}{2} + \cdots\right) x^2$$
$$+ \left(-\frac{y^4}{144} + \frac{y^2}{12} - \frac{1}{6} + \cdots\right) x^3 + \left(-\frac{y^3}{144} + \frac{y}{24} + \cdots\right) x^4 + \cdots$$

Symbolic Integration

Maxima

```
integrate(f(x),x);
```

Maxima

```
trigsimp(trigreduce
(integrate(sin(x)^3,x)));
```

$$\int f\left(x\right)\,dx$$

$$\frac{\cos\left(3\,x\right) - 9\,\cos x}{12}$$

Symbolic Integration

Maxima

```
integrate(x^2*exp(-x^2),x);
```

_____

Maxima

```
float(integrate(
x^2*exp(-x^2),x,1,2));
```

_____

$$\frac{\sqrt{\pi}\,\operatorname{erf}(x)}{4} - \frac{x\,e^{-x^2}}{2}$$

$$0.2332527106719843$$

Symbolic Integration

Maxima

```
expr:'integrate
(2*x*(x^2+1)^3,x);
```

───────────

Maxima

```
exprc:changevar
(expr,x^2+1-u,u,x);
```

───────────

$$2 \int x \left(1 + x^2\right)^3 dx$$

$$\int u^3 \, du$$

Symbolic Integration

Maxima

```
ev(exprc,nouns);
```

───────────────

$$\frac{u^4}{4}$$

Maxima

```
subst([u=x^2+1],
ev(exprc,nouns));
```

───────────────

$$\frac{(1+x^2)^4}{4}$$

Command Summary

diff	differentiate expression
grind	"non-pretty" output
display2d	set to true for pretty output
declare	declare a symbol as constant
depends	establish dependency
integrate	integrate expression
changevar	apply a change of variable

Outline

Simplifying Expressions

factoring and expanding polynomials

Maxima

```
factor(x^2+2*x+1);
```

Maxima

```
expand((x+1)**2);
```

$$(1 + x)^2$$

$$x^2 + 2\,x + 1$$

Simplifying Expressions

Trigonometric expressions

```
Maxima
trigsimp(sin(x)^2
+cos(x)^2);
```

$$1$$

```
Maxima
trigexpand(cos(x+3*y));
```

$$\cos x \, \cos (3\,y) - \sin x \, \sin (3\,y)$$

Simplifying Expressions

Rational expressions

Maxima

```
ratsimp((x^2+2*x+1)/
(x+1)+1/(4*x+3));
```

Maxima

```
ratexpand((x^2+2*x+1)/
(x+1)+1/(4*x+3));
```

$$\frac{4 + 7\,x + 4\,x^2}{4\,x + 3}$$

$$\frac{4\,x^2}{4\,x + 3} + \frac{7\,x}{4\,x + 3} + \frac{4}{4\,x + 3}$$

Simplifying Expressions

Complex exponentials

Maxima

```
demoivre:true;
exp(a+b*\%i);
```

Maxima

```
demoivre:false;
exp(a+b*\%i);
```

$$e^a \ (i \ \sin b + \cos b)$$

$$e^{a+i \, b}$$

Simplifying Expressions

expand(expr,p,n);

Maxima

```
expand((x+1)^5+(x+1)^(-5)
,3,5);
```

Maxima

```
expand((x+1)^5+(x+1)^(-5)
,5,3);
```

$$\frac{1}{x^5 + 5\,x^4 + 10\,x^3 + 10\,x^2 + 5\,x + 1 + (1+x)^5}$$

$$\frac{1}{(1+x)^5} + x^5 + 5\,x^4 + 10\,x^3 + 10\,x^2 + 5\,x + 1$$

Simplifying Expressions

Partial fractions

Maxima

```
partfrac(1/(x^2+3*x+2),x);
```

$$\frac{1}{x+1} - \frac{1}{x+2}$$

Simplifying Expressions

Expressions with logs, exponentials and radicals

```
Maxima

radcan((log(x+x^2)-
log(x))^a/log(1+x)^(a/2));
```

```
Maxima

radcan((\%e^x-1)/
(1+\%e^(x/2)));
```

$$(\log{(1+x)})^{\frac{a}{2}}$$

$$e^{\frac{x}{2}} - 1$$

Simplifying Expressions

Maxima

```
expr:sin(x^2+y^2)-sin(3*x);
eq1:x^2+y^2-x=0;
```

Simplification with rules

Maxima

```
eq2:sin(x)=y;
scsimp(expr,eq1,eq2);
```

$$\sin\left(x^2+y^2\right)-\sin\left(3\,x\right)$$

$$\sin x = y$$

$$y^2+x^2-x=0$$

$$y-\sin\left(3\,x\right)$$

Command Summary

ratsimp	simplify rational expressions
ratexpand	expand rational expressions
trigsimp	converts all trigonometric quantities in terms of $\sin$ and $\cos$ terms
trigreduce	Reduces powers of trigonometric quantities to terms with highest power one
trigexpand	expand trigonometric terms in terms of $\sin$ and $\cos$
radcan	simplify expressions with logs, exponentials and radicals

Outline

Programming with Maxima

$$P_0(x) = 1$$
$$P_1(x) = x$$
$$nP_n(x) = (2n-1)xP_{n-1}(x) - (n-1)P_{n-2}(x)$$

```
Legendre1(n, x) := block ( [],
  if n = 0
   then 1
  else if n = 1
   then x
  else  ((2*n - 1)*x*Legendre1 (n - 1, x)
   - (n - 1)  *Legendre1 (n - 2, x)) / n )
```
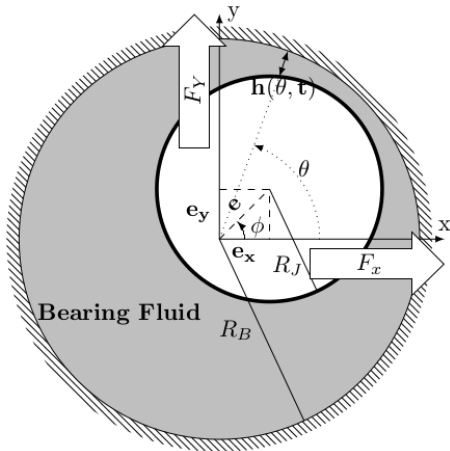
What has NOT been covered

- ▶ Numerical Integration
- ▶ FFT
- ▶ ODEs
- ▶ Advanced plotting
- ▶ Orthonormal series and transforms
- ▶ Inequalities
- ▶ Programming with Maxima

A quick example I

Required,

$$\begin{Bmatrix} F_X \\ F_Y \end{Bmatrix}$$

and derivatives $\dfrac{\partial}{\partial e_x}$, $\dfrac{\partial}{\partial e_y}$, $\dfrac{\partial}{\partial \dot{e_x}}$,

and $\dfrac{\partial}{\partial \dot{e_y}}$

A quick example II

$$F_r = -\mu R L \left(\frac{L}{c}\right)^2 \left[(\omega - 2\dot{\phi})\frac{\epsilon^2}{(1-\epsilon^2)^2} + \frac{\pi}{2}\frac{(1+2\epsilon^2)\dot{\epsilon}}{(1-\epsilon^2)^{5/2}}\right]$$

$$F_t = \mu R L \left(\frac{L}{c}\right)^2 \left[(\omega - 2\dot{\phi})\frac{\pi}{4}\frac{\epsilon}{(1-\epsilon^2)^{3/2}} + \frac{2\epsilon\dot{\epsilon}}{(1-\epsilon^2)^2}\right]$$

```
depends([e],t)$
ex:0.3*50.8e 6*cos(%pi/4)$
ey:0.3*50.8e 6*cos(%pi/4)$
exd:0.1*ex*omega$
eyd:0.1*ey*omega$
epsilon:sqrt(e[x]**2+e[y]**2)/c$
phi:atan2(e[x],e[y])$
```

A quick example III

```
Fr : mu*R*L*(L/c)**2*((omega 2* d i f f ( phi , t ))*
e p s i l o n **2/(1 e p s i l o n **2)**2 + %pi *(1+2* e p s i l o n **2)*
d i f f ( e p s i l o n , t )/(2*(1 e p s i l o n **2)**(5/2)))$

Ft :mu*R*L*(L/c)**2*((omega 2* d i f f ( phi , t ))*
% pi * e p s i l o n /(4*(1 e p s i l o n **2)**(3/2)) +
2* e p s i l o n * d i f f ( e p s i l o n , t )/(1 e p s i l o n **2)**2)$

Fx : radcan ( Fr *cos ( phi ) Ft * s i n ( phi ))$
Fy : radcan ( Fr * s i n ( phi )+Ft *cos ( phi ))$

FxFy : t r a n s p o s e ( matrix ([ Fx , Fy ]))$
```

A quick example IV

```
vals : [mu=0.00689, c=50.8e 6 , L=12.7e 3 , R=25.4e 3 ,
diff ( e [ x ] , t )=exd , diff ( e [ y ] , t )=eyd , e [ x ]=ex , e [ y ]=ey ,
omega=10000*2*% pi / 60]$

float ( subst ( vals , FxFy ) );
float ( subst ( vals , diff ( FxFy , e [ x ] ) ) );
float ( subst ( vals , diff ( FxFy , e [ y ] ) ) );
float ( subst ( vals , diff ( FxFy , diff ( e [ x ] , t ) ) ) );
float ( subst ( vals , diff ( FxFy , diff ( e [ y ] , t ) ) ) );
```

Setting up imaxima on emacs I

```
(add-to-list 'load-path "/usr/share/maxima/5.37.2/emacs")
(autoload 'maxima-mode "maxima" "Maxima mode" t)
(autoload 'imaxima "imaxima"
        "Frontend for maxima with Image support" t)
(autoload 'maxima "maxima" "Maxima interaction" t)
(autoload 'imath-mode "imath"
        "Imath mode for math formula input" t)
(setq imaxima-use-maxima-mode-flag t)
(add-to-list 'auto-mode-alist '("\\.ma[cx]" . maxima-mode))
(setq imaxima-fnt-size "Large")

(autoload 'emaxima-mode "emaxima" "Emaxima" t)
(add-hook 'emaxima-mode-hook 'emaxima-mark-file-as-emaxima)
(setq emaxima-abbreviations-allowed t)
```
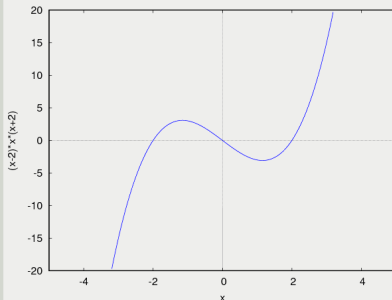
Setting up imaxima on emacs II

Useful Links

1. http://maxima.sourceforge.net/
2. https://sourceforge.net/projects/wxmaxima/ (recommended front end)
3. http://web.csulb.edu/~woollett/ (great resources)

Thank You!

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