MAE 5803 - Homework #2 Problem #1

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Tim Coon: 9, February 2017

```
clear; close all; clc;
```

Norm Regions

The norm used in the definitions of stability need not be the usual Euclidian norm. IF the state space is of finite dimension, n, stability and its type are independent of the choice of norm. However, a particular choice of norm may make analysis easier. For $n = 2$, draw the regions corresponding to the following norms.

$$||x||^2 = x_1^2 + x_2^2 \leq 1$$

$$||x||^2 = x_1^2 + 5x_2^2 \leq 1$$

$$||x|| = |x_1| + |x_2| \leq 1$$

$$||x|| = sup(|x_1|, |x_2|) \leq 1$$

Eqn #1: Euclidean Norm

Plot $x_1^2 + x_2^2 = f_1$ for $f_1 \leq 1$.

```
f{1,1} = @(x1,x2) x1.^2 + x2.^2;
f{1,2} = '||x||^2 = x^2_1 + x^2_2 \leq 1';
```

Eqn #2:

Plot $x_1^2 + 5x_2^2 = f_2$ for $f_2 \leq 1$.

```
f{2,1} = @(x1,x2) x1.^2 + 5*x2.^2;
f{2,2} = '||x||^2 = x^2_1 + 5x^2_2 \leq 1';
```

Eqn #3:

Plot $x_1^2 + x_2^2 = f_3$ for $f_3 \leq 1$.

```
f{3,1} = @(x1,x2) abs(x1) + abs(x2);
f{3,2} = '||x|| = |x_1| + |x_2| \leq 1';
```

Eqn #4:

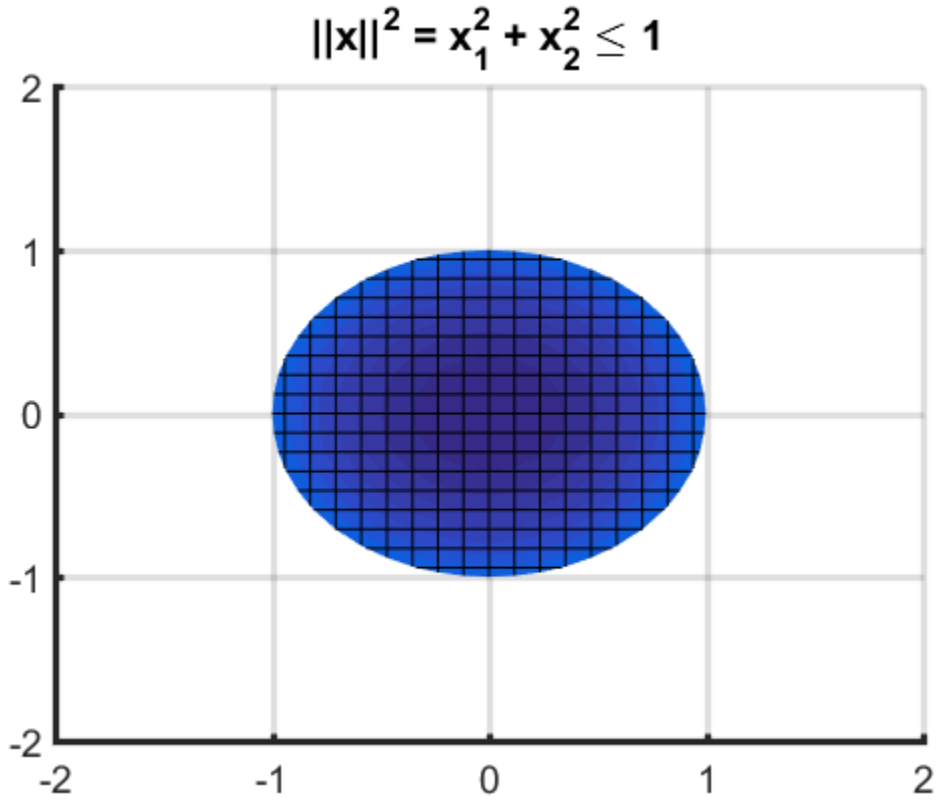
Plot $x_1^2 + x_2^2 = f_4$ for $f_4 \leq 1$.

```
f{4,1} = @(x1,x2) max(abs(x1),abs(x2));
f{4,2} = '||x|| = sup(|x_1|,|x_2|) \leq 1';
```

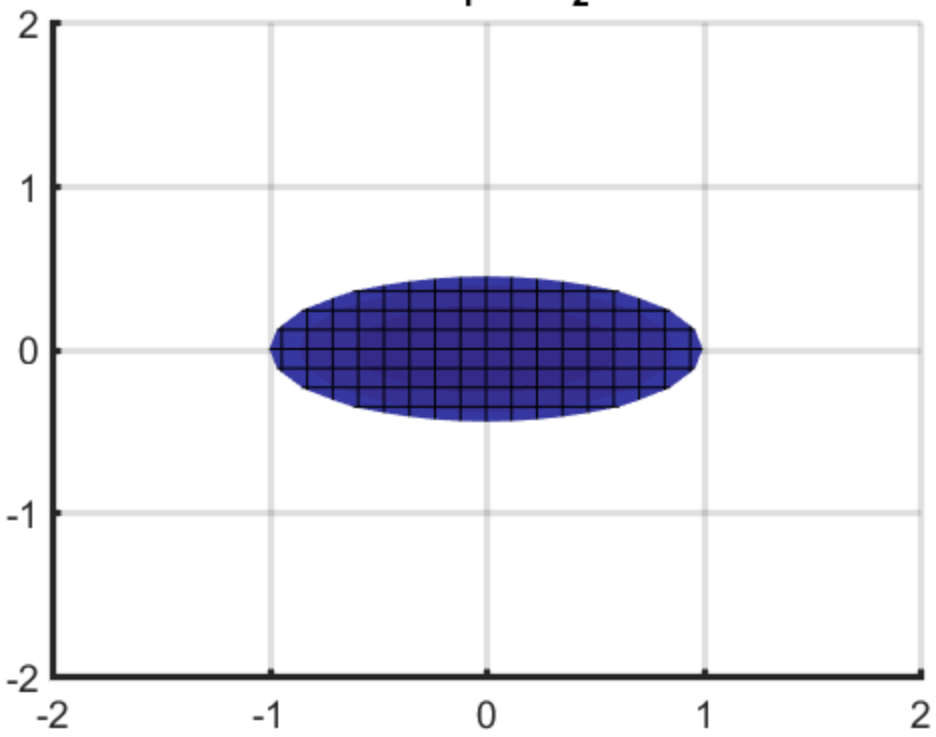
Plots

The 2-dimensional function is plotted for the specified region by simply limiting the region in the tangential direction and viewing normal to the x1-x2 plane.

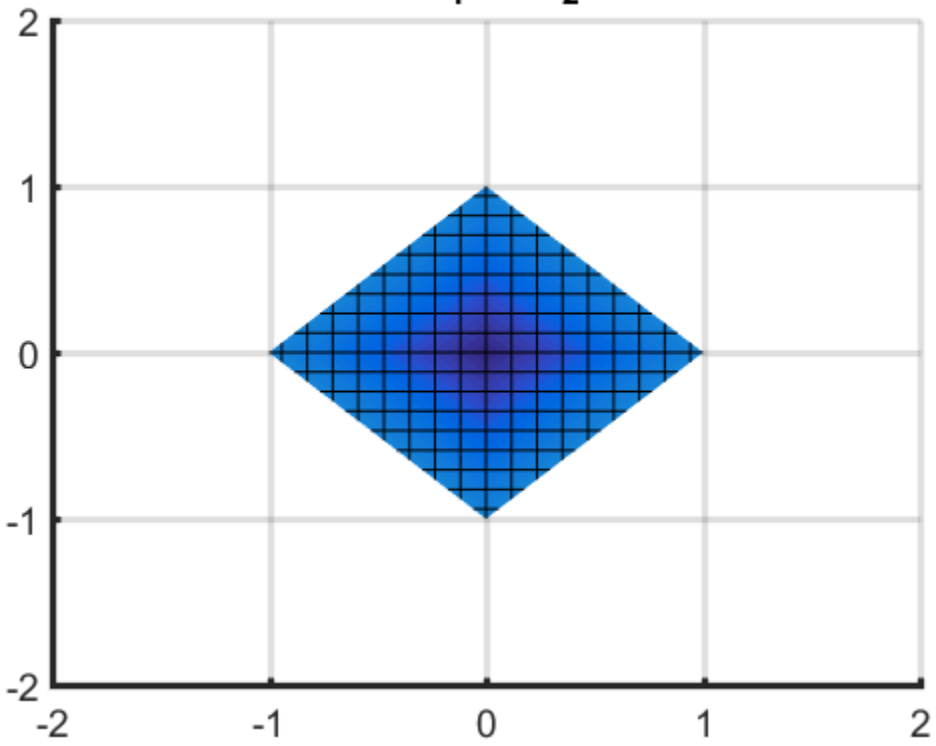
```
for i = 1: length(f)
    figure(i);
    fsurf(f(i,1))
    xlim([-2 2]); ylim([-2 2]); zlim([0 1]);
    view(2)
    title(f{i,2},'Interpreter','tex')
end
```

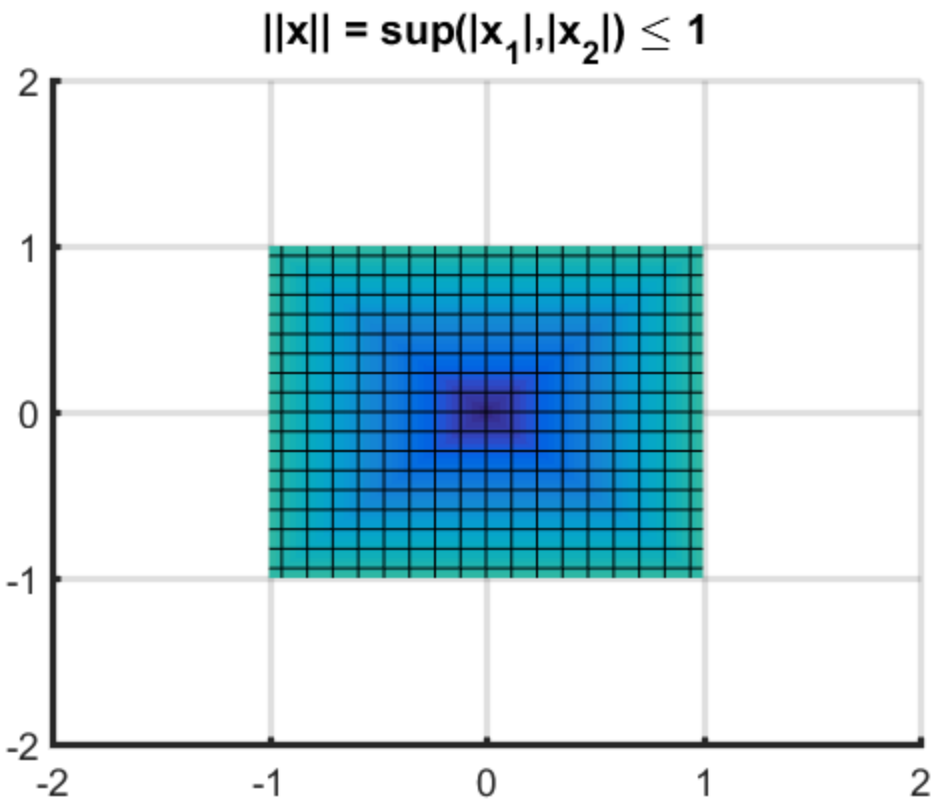


$$||x||^2 = x_1^2 + 5x_2^2 \leq 1$$



$$||x|| = |x_1| + |x_2| \leq 1$$





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