Final Ex.

1. Consider
2. In order to show the origin of the unforced system is asymptotic stable, define
3. Show is positive definite.

* Sol:

Since

i.e.,

And

1. Determine whether is radially bounded or unbounded.

* Sol: For ,

If , , however

but it is bounded, is not radially bounded.

1. Show the origin of is asymptotic stable.

* Sol: Its time derivative along the trajectory is

Hence it is asymptotic stable, but not globally.

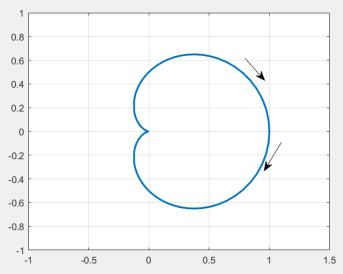
1. Assume the output of is . Using the circle criterion, change into an absolute stability form as

G(s)

2.1) Show

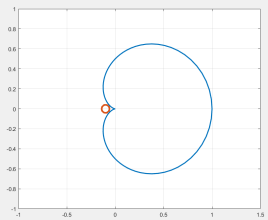
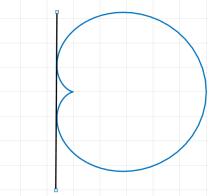
* Sol: To get the

2.2) Let the Nyquist plot of is



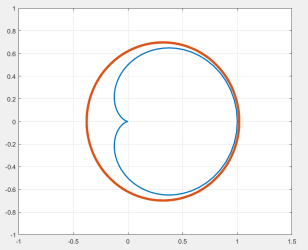
find a sector to guarantee the to be absolute stable.

1. where

* Sol: If

🡪

if

* Sol:

%%% what is difference between 1) and 2) ? %%

1. State feedback stabilization

Consider

* 1. Find the equilibrium point.
* Sol:
  1. Check the origin ’s stability by linearizing at the origin
* Sol:

The linearized system matrix

, whose eigenvalues are 1+/- 1i 🡪 unstable

* 1. Design a state feedback to asymptotic stabilize the globally
* Sol:

Select

Take the state feedback controller as

Then

1. Consider
2. Linearize and design a controller to stabilize at the origin (0,0) of the linearized closed feedback system with poles -1 and -2

* Sol:

Take , is asympt.stable

1. Using this controller, the closed loop is locally asymptotical stable. For the global asymptotical stability, design a state feedback controller

* Sol: Select

The time derivative is

Design as

The closed loop system is

If 🡪 is asymptotic stable globally.

1. With an additional integrator, design to stabilize globally the

* Sol:

Let define . The first two equations are

Select . The time derivative is

Hence take

Since --> is globally asympt. stable

Now define . Then

And

Take a , its derivative is

Here

Together

Design as

Then

Since is globally stable, the closed loop is globally stable.

1. Sliding mode

Consider a linear system as

1. When show that if the initial point of is in the one of the eigenvector, is also in the eigenvectors

* Sol:

The unforced system is

If is a eigenvector of , then

where is a constant , i.e., is an eigenvector

1. One of the eigenvector is . Define a straight line , which is a slinging curve, such that . . Plot the straight line in the - phase plane.

* Sol:

S

1. Define show that along the trajectory.

* Sol:

Hence if converges to zero

1. Assume there is a disturbance into the system as

Design such that , in the finite time will be reached the .

* Sol:

Since ,

Select , Then if ,

If if ,

Hence

--The EnD--