Week\_4 Calculus of Variation Home assignments.

Problem 1.

The Cost function .

There are two constraints as

The Hamiltonian(adjoint index) is

The necessary conditions are

The Method\_1 :

-. 5th order linear equation:

The Method\_2: symbolic math in matlab

%% Home assignment\_1

clear all; clc;

syms x y z la1 la2

f1 = x +2\*y +3\*z -10;

f2 = x -y +2\*z -1;

H = x^2 + y^2 + z^2 + la1\*f1 + la2\*f2;

eqns =[f1==0, f2==0, diff(H,x) == 0, diff(H,y) ==0, diff(H,z)==0];

S= solve(eqns,x,y,z, la1,la2)

[S.x;S.y;S.z]

>> ans: [ 19/59, 146/59, 93/59]

Problem\_2

The adjoined equation is

The necessary conditions are

Using symbolic math

%% Home assignment\_2

clear all; clc;

syms x y a b la

f = x^2/(a^2) + y^2/(b^2) -1;

H =4\*(x+y) +la\*f;

eqns =[f==0,diff(H,x) == 0, diff(H,y) ==0];

S= solve(eqns,x,y,la)

[S.x,S.y]

4\*(S.x + S.y)

simplify(4\*(S.x + S.y))

>> ans

[ a^2/(a^2 + b^2)^(1/2), b^2/(a^2 + b^2)^(1/2)]

[ -a^2/(a^2 + b^2)^(1/2), -b^2/(a^2 + b^2)^(1/2)]

>> ans

(4\*a^2)/(a^2 + b^2)^(1/2) + (4\*b^2)/(a^2 + b^2)^(1/2)

>> ans

4\*(a^2 + b^2)^(1/2) =

Problem\_3

The adjoined equation is

The necessary conditions are

It is a nonlinear coupled equation, coupled as U see ….Try to use symbolic math

%% Home assignment\_3

clear all; clc;

syms x y z a b c la

f = x^2/(a^2) + y^2/(b^2) + z^2/(c^2)-1;

H =8\*(x\*y\*z) +la\*f;

eqns =[f==0,diff(H,x) == 0, diff(H,y) ==0,diff(H,z)==0];

S= solve(eqns,x,y,z,la);

[S.x,S.y,S.z]

>> ans

ans =

[ -a, 0, 0]

[ 0, -b, 0]

[ 0, 0, -c]

[ (3^(1/2)\*a)/3, -(3^(1/2)\*b)/3, -(3^(1/2)\*c)/3]

[ -(3^(1/2)\*a)/3, (3^(1/2)\*b)/3, -(3^(1/2)\*c)/3]

[ -(3^(1/2)\*a)/3, -(3^(1/2)\*b)/3, (3^(1/2)\*c)/3]

[ **(3^(1/2)\*a)/3, (3^(1/2)\*b)/3, (3^(1/2)\*c)/3]**

[ -(3^(1/2)\*a)/3, -(3^(1/2)\*b)/3, -(3^(1/2)\*c)/3]

[ (3^(1/2)\*a)/3, (3^(1/2)\*b)/3, -(3^(1/2)\*c)/3]

[ (3^(1/2)\*a)/3, -(3^(1/2)\*b)/3, (3^(1/2)\*c)/3]

[ -(3^(1/2)\*a)/3, (3^(1/2)\*b)/3, (3^(1/2)\*c)/3]

[ a, 0, 0]

[ 0, b, 0]

[ 0, 0, c]

Now the can be find as

>> S.x(7)\*S.y(7)\*S.z(7)

(3^(1/2)\*a\*b\*c)/9

Week\_4 Transfer function Home assignments.

* Home assignment

System matrix: , input matrix:

* What is the transfer function from u to y if

2.1 Problem\_1: Transfer function from to

System matrix:

Input

Output

The state space equation is

Hence

Transfer function is

In matlab

clear all; clc

syms s a b k

A =[ 0 1; -a -b];

B =[0 1]';

%C = [ 1 0];

C = [ 1 0];

I = eye(2,2);

TR\_open = C\*inv(s\*I-A)\*B

>> TR\_open =

1/(s^2 + b\*s + a)

% close loop

FK = [k 0];

TR\_closed = C\*inv(s\*I-(A-B\*FK))\*B

>> TR\_closed =

1/(s^2 + b\*s + a + k)

2.2 Problem\_2 Transfer function from to

Transfer function is

>> %% in matlab

TR\_open =

s/(s^2 + b\*s + a)

TR\_closed =

s/(s^2 + b\*s + a + k)

2.3 Problem\_3: to

Transfer function is

In matlab

>> TR\_closed =

1/(a + k1 + b\*s + k2\*s + s^2)

2.4 Problem\_4: Transfer function from to

In matlab

>> simplify(TR\_closed)

ans =

(s + 1)/(a + k1 + b\*s + k2\*s + s^2)

%%%% comments -----------

As you see, the optimal problems are usually difficult to be solved. Complicated.tedius.boring…

Symbolic math is one of the wonderful tools. I found an error in our textbook in this course!

Since 40 years ago it was very difficult to solve parametric equations. If U did not have a super computer, it was impossible. But I can solve those in my small PC so that I found an error. I think symbolic math is a tool, which provides us with an analytic solution without boring and being tedious, and We may see what’s the happening this parameter into the system. Of course, there are limitation of symbolic math.

I saw several Master thesis’s in ASTU, usually in matlab, simulink simulation….We may introduce another ways, not just simulation but analysis using symbolic math.

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