Problem: 2.

Consider a moon lander with state

following dynamics.

L'(+) = 11(+) (H) = - 9 + a(H) /m (H)

here h is the altitude, it is the nelocity, and mis mass of the moon lander altico, i), is thoust, and K Is a constant suel burning eate. Let the initial state be [ho, vs, most and target h(++)=0 y(+)=0

-> some aditional construirs that

The goal here is to minimize the flught consumpting which mean coe need to ministry the mass mux m (t)

ashere Tir the first tim h(t)= U(T):0 =1 we can see arct) = - m(t), so if coe

minimize total applied thrust before lunding is as equal as the maximizing the mass of moon lander which give as the minimal fuel consumption, so,

min factidt = mo-m(T)

In terms of general notation Vectors.

Henre the Hamilternian H=-L+XTf=>-9+X,V+X2(-9+9)+X3(-K4)

96 [011]

where b=-1+1/2 - 13K the gyess policy a(t)= { o for te[o, t]

In order to prove the guess of optimal policy we need to show that the bis either manotonaically increasing or decoloring

150 
$$b = \lambda_{\epsilon} - \lambda_{\epsilon} = \lambda_{3} \times \sum_{m=1}^{\infty} \lambda_{m}$$

and we know are to adjoint equation  $\lambda_i = \frac{-2H}{2h} = 0 \qquad \lambda_i^* = \frac{-2H}{2h} = -\lambda_i$ 13 = - 2H = 129

patting of the & value in & B= -71 -750-Ka)-(750)K

16: - - XI

when the engin thus, the dynamics become

Now as we have switching condition when to engine Ithough start or when to stop ween to our quessiso here first I defined the dynamics is off no thrust, t E (0, to)

(1)

1, (+) = 1, (+) 10 (+)= 0 here met)=0 => fm(+)dl=fold

and are know at starting m=mo there is no throat untill the 20 at tue = wo 1 20 5' = wo

[w: wo]

v = -9

coe know at time t=0 x=10

$$\int_{0}^{2\pi} \int_{0}^{2\pi} \int_{0}^{2\pi$$

at to he ho ho = 63

So, I here  $(t) = \frac{-1}{\xi}gt^2 + 4v_0 + h_0$   $v_{free}(t) = -gt + v_0$   $m_{free}(t) = m_0$ 

mow one are considering the another condition oben a = 1, mean engine man

. The following dynamics at te [tx, T]

Ji. J-g-1 H  $\int_{y=0}^{0} -g + \frac{1}{m_0 + k(p-1)}$ V= -gt + Log (mo+K(++-+1) +c, we know at t=T · V(t)=0 0 = -g(T) + Log(mo+K(L++-T) +C) 10, - 9T - log(mo+K(++-T) 30. V= -gt + log(mo+k(+\*-1))+g(T)-Log cmo + KC (+-T) N=g(T-+) + [log [mo + K(t'-t)] h = Y Sh = SV h = Jg(t-+) + 1/09 [mo+K(+\*-+)]

-) Bue to limited grace in my note book edicylente it on side and of ten colculation

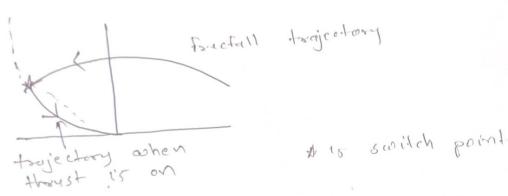
more let put t-th in equation when dil anazo hroce (fr) = - 1 g Ext + Ed votho

By using the above equations equations equations electronice

= 1/p(+1) and 1/p(-11) are com determine

the found to value

-> now we can vizulize the system or



-> row we contr bouk to the b' equation

manuforically increasing function because by

The reason - N is mot choose the because are can not use throws before the swithing point if this is a case so the velocity at the end can not be zero

so u(t):

() if by on (to to)

-) earlier guess of all does indeed the bourge adam waximmen barnible. or also the optimal control just change once from a tol, and the Wb on Porto) byo .00 - 640,00 とナエノて了。