CONTROL DESIGN

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AE 483

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Write equations of motion in standard form: s = f(s, i, p)

parameter

input

state - ordinary differential equations Choose an equilibrium point: this is unconventional - parameter values are 0 = f(seq, ieq, Peq) usually given and not chosen - but it makes the notation easier when we implement with code Linearize equations of motion about equilibrium point: $\dot{x} = Ax + Bu$ $\dot{x} = A \times + Bu$ $\dot{x} = 1 - i_{eq} \leftarrow input$ $\dot{x} = - s_{eq} \leftarrow s_{tate}$ Constant: A, B, Seq, iec Functions of time: x, u, s, i

A =
$$\frac{\partial f}{\partial s}$$
 (Seq, ieq, Peq) B = $\frac{\partial f}{\partial i}$ (Seq, ieq, Peq)

$$\dot{x} = A \times + Bu$$
 $\dot{x} = S - Seg$ $u = i - ieg$

Design linear state feedback that makes the state go to zero

 $u = -IK \times \qquad \dot{x} = A \times + B(-K \times) = (A - BK) \times \qquad if all eigenvalues of A - BK have negative real part, then $\dot{x}(t) \Rightarrow 0$ are $t \Rightarrow bo$

Lar is a standard THIS MEANS: $\dot{x}(t) \Rightarrow Seg$ way to choose K

winimize $\int_{0}^{\infty} (\dot{x}(t)^{T}Q \times (t) + u(t)^{T}R u(t)) dt$
 $\dot{x}(t) = A \times (t) + B u(t)$, $\dot{x}(0) = \dot{x}_{0}$
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 $\dot{x}(t) = \dot{x}(t) + \dot{x}(t)$$

x = Ax+Bu x=S-Seq u= (- jeg SYSTEM u=-Kx CONTROLLER x(t) > xdes as t-200 Add reference tracking $u = -K(x - x_{des})$ - desired value of x (what you want x to become, if not zero) If you could have chosen any value for the jth element of seg and 1) still have an equilibrium point 3 still have produced the same A and B then the jth element of Xes can be any non-zero number you want - all other elements of xdes must be zero.

SYSTEM
$$\dot{x} = A \times + Bu$$
 $\dot{x} = S - Seq$ $u = i - ieq$
Controller $u = -K(x - x_{des})$

IMPLEMENTATION

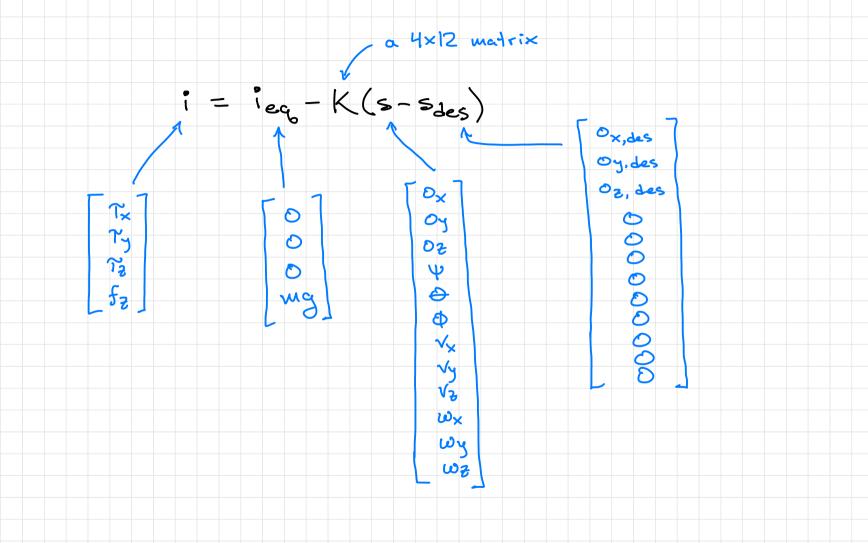
$$i - i = -K(x - x_{des})$$

$$i - i = -K((s - seq) - (sdes - seq))$$

$$= -K(s - sdes)$$

$$= -K(s - sdes)$$

$$= -K(s - sdes)$$



CONTROL LOOP desired position state get 0x,0y,0z, 4,0,0, vx, vy, vz, wx, wy, wz and oxdes, oydes, ozdes choose 7x, 7y, 7z, fz <= i=ieq-K(s-seq) choose m,, mz, mz, my motor power commands