04 -- Thu Apr 9

AA/ECE/ME 548: Linear Multivariable Control

Prof Burden   TA Tinu   Spring 2020

if/when possible: keep video on; unmute to ask Q's

* specify your preferred name at identity.uw.edu
  (Zoom should use this name – can't change in Zoom profile)

today:
- [x] HW0 solution & self-assessment
- [x] HW1 Q's ← due 5p tomorrow (Fri Apr 10)
- [x] MIMO systems: margins, tradeoffs, & limits
- [ ] Prof OH

* feel free to use example code (from me or other sources)
  → cite your source

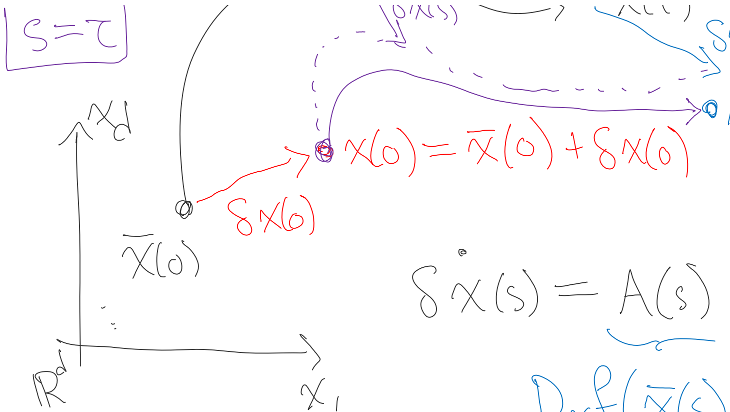
HW1 P2

(a) given $\bar{x}(0) = 0$, $\bar{u} : [0,t] \to \mathbb{R}^m$, let $\bar{x} : [0,t] \to \mathbb{R}^d$
be the corresponding trajectory $x(\tau) = (q(\tau), \dot{q}(\tau))$

i.e. if $x(0) \mapsto x(0) + \delta x(0)$, then $x(s) \mapsto x(s) + \delta x(s)$

$\bar{x}(s)$ $\dot{\bar{x}}(s) = f(\bar{x}(s), \bar{u}(s))$

$\boxed{s = \tau}$



$$x(t) = \bar{x}(t) + \delta x(t) + O(\|\delta x(0)\|)$$
$$\simeq \bar{x}(t) + \delta x(t) \text{ when } \|\delta x(0)\| \text{ small}$$

$$\delta \dot{x}(s) = \underbrace{A(s)}_{D_x f(\bar{x}(s), \bar{u}(s)) = \frac{\partial}{\partial x} f \in \mathbb{R}^{d\times d}} \delta x(s) + \underbrace{B(s)}_{D_u f(\bar{x}(s), \bar{u}(s)) = \frac{\partial}{\partial u} f \in \mathbb{R}^{d\times m}} \cdot \delta u(s)$$

<u>fact</u>: linearization of CT flow is obtained by solving so that $D_\xi \phi(s, \xi) = X(s)$, where $X : [0,t] \to \mathbb{R}^{d\times d}$ solves

$$\frac{d}{ds} X(s) = A(s) \cdot X(s), \quad X(0) = I$$

in particular:
$$\underbrace{D_2 \phi(s, x(0))}_{X(s)} \cdot \delta x(0) = \delta x(s)$$
$$X(s) \cdot \delta x(0) = \delta x(s)$$

where $\frac{d}{ds} \delta x(s) = A(s) \cdot \delta x(s)$