	Lacture 4 Date OM
	Diagonalization, Model Analysis, Into to Fredbork
	3
*	Similarity Tonansform
	Let T be an invertible matrix, and consider
	Let T be an invertible modrix, and consider a coordinate transformation X=TX.
0	The state of the s
7 41	L> This is called similarity transform.
	Da I I I I Car be
=	The standard stato-space model can be written as:
3.	= IX-AX+BU TX=ATX+BU
	$\Rightarrow \begin{array}{ c c c c c c c c c c c c c c c c c c c$
21	
	=> == (T-'AT) = + (T-'B)4
	Y= CT) X + DU
	$\tilde{\Sigma} \sim \tilde{\Sigma} \sim $
	=> = A = T-IAT Where A = T-IAT
	$Y = \widetilde{C} \times + \widetilde{D} U$ $\widetilde{C} = CT$
	Jo Ji Malatalah ja D = O
	in the constant of the state of
->	The Choice of a State-space model for a
	The Choice of a State-space model for a giver system is not unique.
· Anna	
at a	in a grand to the contract of
1/6	where sail and so we destruction
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ninoho etinomija yvotetii ili o	A LEW VINCEY
madinizanacio (paraginari) m. 25º	A JEN VIVEY



* Controllability and Observability

A LTI system of the form X=Ax+Bu
is said to be controllable if for any
given initial state X(0) = Xc there exists a
Control signed that takes the State to the
Origin X(t) = 0 for some finile time to

A LTI system of the form $\dot{x} = Ax + By$, $\dot{y} = Cx + Dy$ is said to be observable if

any given with a condition $x(o) = x_0$ can

be one constructed based on the knowledge.

of the octpet and input signed only over a

finite time interval Fo, G.

→ An LTI System is stabilizable if all unstable modes are controllable.

=> An LTI system is detectable if all unstable modes are observable.

* Diagonalization

eigenvoctors; then we can assemble the eigenvoctors into an inventable moder V whose columns are the eigenvoctors V;

 $V = [V, V_2 - - V_n] \wedge = [h]$



So AV=VA

* Modal Coordinates

=> Eigenvalue and eigen vactoris of A define the modes of the system.

The toransformed coordinates X(t)=VX are colled model coordinates.

=> The eigenvoitor V; define the Shape of the

of the mode evolves over time.

=> Lat (x(t) = Ax(t) bo the system.

=> Let V= [V, V2 -- Vn] be the eigen voitor maix

=> Let 1 = [> n] be eigenvolve metaix.

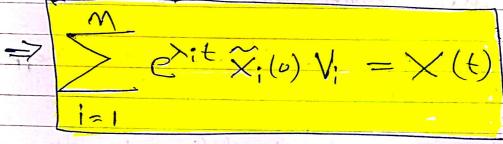
=> 2 H X(t) = V \(\hat{\chi}(t)

 $\Rightarrow \hat{\mathbf{x}} = (\mathbf{v} - \mathbf{v})\hat{\mathbf{x}} \qquad \hat{\mathbf{x}} = \mathbf{v} - \mathbf{v}$

 \Rightarrow $\hat{x}(t) = \Lambda \hat{x}(t)$

 $\Rightarrow \chi(t) = e^{\Lambda t} \tilde{\chi}(0)$ $\Rightarrow \sqrt{-1} \chi(t) = e^{\Lambda t} \sqrt{-1} \chi(0) e^{\Lambda t} \tilde{\chi}(0)$

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$(f) = AGV \lesssim$	(o)
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[V, V2 Vn]	ent ?
	emt e



- Any trajectory can be expressed as a linear combination of modes.
- Pole placement First and a systems
- Consider a first order control system with dynamics is = ax + bu, and assume that we are not happy about its behaviour
- The dynamic would be it is

 $\dot{X} = (\alpha - bK)X$

=> As long as b + o (i.e. the System is contallable)

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by choosing $K = (\alpha - \alpha^*)/b$, we can place the "Clusted-loop" eigenvalue at a desired value α^* , on any where we wat on the oreal axis!

=> This is the simplest orangle of a general technique colled "pule planment".

* Effect on foodback for clusted-loop dynamics

= If we have an open-loop LTE system

 $\chi(t) = Ax(t) + Bu(t)$ $\chi(t) = Cx(t)$

=> By choosing a linear feedback U=-KODY =-KCX, we can transform it Into another , closed-loop LTI system:

 $\frac{1}{2}(\xi) = (A - BKC)X(\xi)$ $\frac{1}{2}(\xi) = (X(\xi))^{-1}(\xi)$

off cits and the biggen K, the faster the closed of system is, and the smaller the error are.

=> However this is not generally the case.