

• The Big Picture

• Modeling

- Input / output
- state space (preferred method)

• Performance Issues

- mimo systems
- large vs. small
- singular values

$$\sigma_i[m] \equiv \sqrt{\lambda_i(m^*m)}$$

\swarrow \nearrow \swarrow \nearrow
 i^{th} singular value matrix i^{th} eigenvalue

$$m^* \equiv [\tilde{m}]^T \quad - \quad \text{conjugate transpose of } m$$

we'll focus on σ_{\max} , σ_{\min}

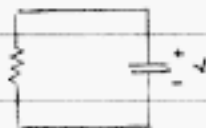
Idea

m "small" $\Leftrightarrow \sigma_{\max}$ "small"

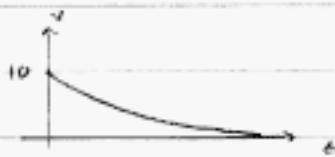
m "large" $\Leftrightarrow \sigma_{\min}$ "large"

• Controllability

- natural modes (poles)



we want to be able to "control"
or "alter" "undesirable" modes.



- observability

we need to be able to "see" or "observe" the bad "stuff" or bad modes.

- State Feedback (LQR) (Linear Quadratic Regulator)

- full information
- access to entire state vector

- State Estimation (Kalman Filters)

- Model Based Controllers

$$= \text{S.F.} + \text{S.E.}$$

- Design Methodologies

- LQG
- LQG/LTR
- H_∞ , H_2