Vehicle Dynamics and Control - ME8287
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1. Kinematic Model for Lateral Vehicle Motion
   a. Sine Rule
   b. Cosine of Angle Sums
   c. Road Radius
   d. Vehicle Slip Angle
2. Dynamic Model for Lateral Vehicle Motion
   a. Force Equilibrium
   b. Total Lateral Acceleration
   c. Moment Equilibrium
   d. Lateral Tire Forces
   e. Slip Angles
   f. Steering Angle for Cornering
   g. Velocity Angles
   h. State Space Representation with Error Coordinates
      i. Lateral Position Error
      ii. Orientation Error
   i. Steady State Steering Angle
      i. Under-Steer Gradient
         1. Neutral Steer
         2. Under Steer
         3. Over Steer
3. State Feedback Control
   a. Transfer Function Representation
   b. Final Value Theorem
   c. Steady State Errors
   d. Feed Forward Term
   e. Controllability
4. Nyquist Criterion
   a. Transfer Function Representation
   b. Open Loop System (Poles and Zeros)
   c. Closed Loop System (Poles and Zeros)
   d. Nyquist Stability Criterion
5. Lead Compensator
   a. Increasing the Robustness
6. Output Feedback Control
   a. Transfer Function Representation
7. Longitudinal Vehicle Motion
   a. Longitudinal Force Equilibrium
      i. Total Longitudinal Acceleration
      ii. Longitudinal Tire Forces
         1. Slip Ratios
         2. Normal Load on the Tire
         3. Tire-Road Friction Coefficient
iii. Aerodynamic Drag Forces
iv. Rolling Resistance
v. Inclination Angle of the Road

8. Longitudinal Control of Vehicle Motion
   a. Cruise Control
      i. Upper Controller
      ii. Lower Controller

9. Automated Highway Systems
   a. Constant Spacing Policy
   b. Constant Spacing Policy with Wireless Communication
   c. Constant Time Gap Policy

10. Non-Linear Dynamic Systems
    a. Stability of Equilibrium Points
    b. Limit Cycles
    c. Stability in the Sense of Lyapunov
    d. Lyapunov Functions
    e. La Salles’ Theorem
    f. Barbalat’s Lemma
    g. Exact Feedback Linearization
    h. Input Output Linearization
    i. Sliding Surface Control

11. Electronic Stability Control

12. Active Automotive Suspension
    a. H2 Optimal Control