Opportunity and Significance

Four-wheel drive electric vehicles provide enhanced controllability and maneuverability. Moreover, the modular design of the vehicle enables the designer to mitigate actuator malfunction effectively while safe driving is guaranteed. Improved travel range and reduced repair services are achieved.

Technical Objectives

We use supervisory control design to guarantee the safe behavior of the vehicle when one actuator is damaged or does not function properly. We design our control such that the yaw angle and lateral position of the vehicle remains close to the reference values when one actuator is lost.

Related Work and State of Practice

We used the following configuration in our work. We use a linearized model of the system to study the control properties of the system and to design our controller.

Accomplishments and Results

- Vehicle remains safe when an actuator is lost
- All combinations are studied
- The system is not controllable if two actuators are lost
- Top figure: front wheels angle
- Middle figure: rear wheels angle
- Bottom figure: yaw moment

Results

The figure below shows longitudinal position and yaw angle error which verifies that the controller maintains the system’s desirable behavior when one actuator is lost.

Next Steps for Development and Test

We expect to design the supervisory control for the full model when each wheel has independent control angle and speed inputs. Also, we plan to implement our algorithm on a small scale electric vehicle. The prototype will be designed and manufactured in-house.

References


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