Full Speed Range Adaptive Cruise Control

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Overview
Full Speed Range Adaptive Cruise Control (FSRACC) adapts the subject vehicle speed to that of a forward vehicle by using information related to the predicted path of the subject vehicle, the distance between the subject and forward vehicles, and the driver’s commands. Given the information collected, an FSRACC controller (housing an FSRACC control algorithm) will determine the needed actions for the longitudinal control of the subject vehicle and consequently send commands to the actuators (brake or throttle) to achieve its longitudinal control strategy. The FSRACC controller will also keep the driver up to date by sending them status information. The following describes pictorially the functional elements of an FSRACC system.

FSRACC is an improvement to current adaptive cruise control (ACC) systems. With FSRACC the distance between the subject vehicle and the forward vehicle is controlled at all speeds leading to stopping the subject vehicle and holding it at that position if the forward vehicle brakes to a stop. As is the case with ACC the following distance between subject and forward vehicles is set by the driver that chooses one of many available appropriate following distances.

This FSRACC system uses the following sub-systems or modules as pictured above:
• Detection of forward vehicles. This is usually achieved using a radar that is mounted to the front of the vehicle and has a forward field of view. The radar emits sets of pulses and determines the distance of objects from the vehicle by measuring the time it takes to get a reflection back. This information is forwarded to the FSRACC Controller.
• Path prediction. This is an algorithm that determines the motion of the subject vehicle given multiple sensing and vehicle dynamics inputs. This information is forwarded to the FSRACC Controller.
• Human Machine Interface. This is the sub-system where the FSRACC and the driver exchange information such as driver inputs or FSRACC status information.
• FSRACC controller. This module receives input from the driver, the environment and the determined motion of the subject vehicle. Using this information, targets are classified and the controller determines which targets are directly in front of the vehicle and decides on how to command the longitudinal control of the vehicle so that the distance between the subject and the identified forward vehicle is maintained per the driver preference.

The normal mode of operation of FSRACC is to be modelled. Such mode includes the following states:

• FSRACC off
• FSRACC active but not engaged
• FSRACC engaged
  o FSRACC controlling the set speed
  o FSRACC controlling the distance between subject and forward vehicle
  o FSRACC holding the vehicle stopped

Another mode of operation would be that due to a failure in the FSRACC system. Failures include that of the sensors detecting forward threats or the FSRACC controller or the engine providing acceleration or the brakes providing deceleration.

A final mode of operation includes the interaction between the driver and the FSRACC system and how can this be achieved. This includes driver commands to set the speed or override the FSRACC system as well as displays providing the driver with status information.

The combination of these mode of operations defines the overall FSRACC system.