System Overviews

An Automated Pedestrian Collision Avoidance (APCA) system is a system “fitted to an autonomous vehicle for the purpose of avoiding pedestrians … without human driver interaction” [1]. In order to accomplish this goal, it should utilize a stereo camera to detect pedestrians in front of the vehicle. Detection of a pedestrian should result in the activation of the vehicle's braking subsystem.

An Electric Power Steering (EPS) system is a system which translates a driver's turning of the steering wheel to appropriate turning of the vehicle's wheels. EPS systems use a sensor to “detect the position and rate of rotation of the steering wheel” [2]. Combined with other input, such as the vehicle's speed, the EPS module applies logic to determine whether an electric motor should be engaged to aid in the turning of the steering column. In the case that the electric motor is engaged, a sensor attached to the motor reports the motor's position back to the main EPS module.

Commonalities

• Sensors: The APCA system uses a set of stereo camera sensors to detect pedestrians in front of the vehicle. EPS systems utilize sensors to detect rotation of the steering column and rotation of the electric steering motor.

• Control of Sub-Systems: The APCA system must be able to control the Brake-by-Wire Actuator sub-system in order to decelerate and apply brakes [1]. Similarly, an EPS system must be able to control the power steering electric motor sub-system.

• Input from Sub-Systems: The APCA system takes feedback from the Brake-by-Wire sub-system and from the sub-system which reports on the vehicle's velocity. The EPS system also takes input from the sub-system which reports on the vehicle's velocity as well as the vehicle's suspension.

Differences

• Modality: The APCA system has essentially one mode, wherein the system adjusts speed when pedestrians are detected. The EPS system used by General Motors has four modes [2]. In Normal Mode the EPS system provides turning assistance in response to steering wheel turning [2]. In Return Mode the EPS system helps the steering column return to neutral after a turn [2]. In Damper Control Mode the EPS system dampens kickback at higher vehicle speeds [2]. In Protection Mode the EPS system “[p]rotects electrical components from thermal damage and excessive current flow if the steering is held all the way to one side in the lock position too long” [2].

• fallback: In the event of a failure of the EPS system steering control falls back to the non-assisted rack and pinion linkage and drivers utilize the steering wheel in the same manner. In the event of the failure of the APCA system, there is no fallback. Drivers must take over the responsibilities of the APCA system themselves: namely detection of pedestrians and braking.
External Inputs: The APCA system must deal with input from the driver as well as from other sub-systems and from the external world. The Pedestrian Sensor is used to detect objects outside of the vehicle. The EPS system takes input only from the driver and the vehicle.

Requirements Questions

- In what states or modes might the vehicle be?
  - In what states or modes might the APCA be?
- How do the Pedestrian Sensors and the main APCA control systems communicate?
  - What information is contained in a packet?
- How does the camera detect pedestrians?
- How long will the system have to react to the detection of a pedestrian?
- What happens when the APCA system fails?
References
