Adaptive Frontlight System (AFS)

Objectives

Model and implement an adaptive vehicle frontlight controll system. The main system functionality is to control frontlights rotation angle when the driver is turning the vehicle.

In order to illuminate the curve more effectively the inner frontlight (i.e. the frontlight locatated on the turning direction side) moves up to 15 degrees while the outer frontlight moves up to 10 degrees. A different angle of rotation provides a significantly wider field of the view. For sake of simplicity, the frontlights rotation angle is calculated as a linear function of the steering wheel rotation angle.

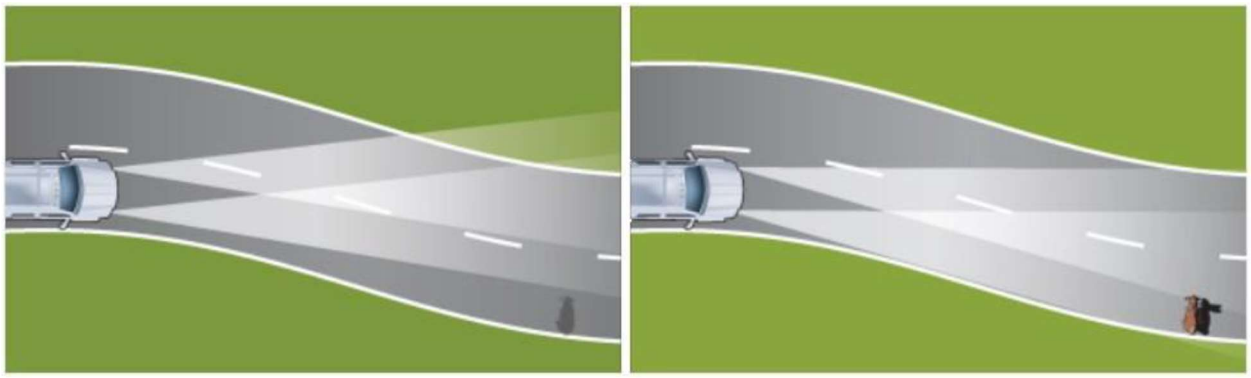

Figure 1- Basic functionality of an adaptive vehicle frontlight control system

Functional requirements

The ECU shall implement the following SWCs:

- CtCddIoHwAb
  - Hardware abstracion SWC
  - Handles Dio channels I/O
- CtApAFSController
  - Control SWC
  - Implements an adaptive vehicle frontlight control alghoritam
  - Triggered on data reception
- CtSaSteeringWheel
  - Sensor SWC
  - Provides information about steering wheel position to Control SWC
  - Time trggered on 100ms
- CtSaFrontlight
  - Actuator SWC
  - Reads and scales frontlight position data from Control SWC
  - Scaling factor: `HorizontalAngle * 30 / 200`
  - Controls the frontlights (left / right)
  - Triggered on data reception

Technical details

Dio channels:

Dio channels	Description
env_AFSSwitch	Switch on/off AFS system
env_HighBeamSwitch	Frontlight intensity

CAN signals:

CAN Msg	Signal	Delegation Port	Size (b)	Description
msg_Rear_2_MyECU	sig_SteeringWheelPosition	PpSWPositionDelegationReceive	8	Steering wheel position
	sig_CurrentSpeedSlider	PpCurrentSpeedDelegationReceive	8	Current vehicle speed
	sig_AmbientLightBrightness	PpAmbientLightDelegationReceive	8	Ambient light intensity
msg_MyECU_2_Rear	sig_LeftHAngle	PpLeftHAngleDelegationSend	8	Left frontlight rotation angle
	sig_LeftMode	PpLeftModeDelegationSend	2	Left frontlight mode
	sig_RightHAngle	PpRightHAngleDelegationSend	8	Right frontlight rotation angle
	sig_RightMode	PpRightModeDelegationSend	2	Right frontlight mode

Note: For signals smaller than 8 bits use `uint8` type to describe port data elements.

Frontlights modes:

Signal value	Mode
00	CITYMODE
01	COUNTRYMODE*
10	MOTORWAYMODE
11	HIGHBEAM

* Default mode

Currently only COUNTRYMODE and HIGHBEAM modes shall be supported.

Acceptance criteria

The system behaviour shall conform the following use cases:

Use case #	Input			Output		
	AFS switch	High beam switch	Steering wheel position	Left frontlight rotation angle	Right frontlight rotation angle	Frontlight mode
1	0	0	-50%	0°	0°	COUNTRYMODE
2	1	0	-100%	-15°	-10°	COUNTRYMODE
3	1	0	-50%	-7°	-5°	COUNTRYMODE
4	1	0	0%	0°	0°	COUNTRYMODE
5	1	0	50%	5°	7°	COUNTRYMODE
6	1	0	100%	10°	15°	COUNTRYMODE
7	1	1	-50%	-7°	-5°	HIGHBEAM
8	1	1	50%	5°	7°	HIGHBEAM