Investigation of the Combination of Kinematic Path Planning and Artificial Potential Field Path Planning with PI Controller for Autonomous Emergency Braking Pedestrian (AEB-P) System

Z. Abdullah, P. M. Heerwan, M. A. Zakaria, and M. I. Ishak

Abstract Autonomous Emergency Braking Pedestrian (AEB-P) is a fundamental capacity of the advanced driver assistance system (ADAS) to maintain a distance and avoid a collision. The fatality of pedestrian in traffic accident as well as near-miss accidents are the most frequent type of accidents in Malaysia as the improvisation of AEB-P system are obligatory. To generate optimum vehicle deceleration from the path planner in the presence of a pedestrian in front of the vehicle, an Artificial Potential Field (APF) path planner with a kinematic path planner is proposed in this research. The kinematic path planner will produce maximum deceleration for the vehicle, 8 m/s^2, as the vehicle violates the threshold. The value is combining with the APF value to fetch to the PI controller. Thus, the AEB-P system was designed considering the pedestrian walked in front of the vehicle at 4.32 km/h and vehicle travelled at 60 km/h, dry and wet road surface condition, time for Front Collision Warning (FCW), and full braking was included for the limit APF is developed. The PI controller will tune the deceleration using its variable on dry road surface (P = 0.003, I = 5) and on wet road surface (P = 0.003, I = 8500). The host vehicle starts to give warning signal at 37.29 m and experience full braking at 21.3 m when the vehicle travel on both types of surfaces. The vehicle manages to stop from hitting the pedestrian at 2.21 and 1.5 m on the dry and wet road surface. The proposed AEB-P architecture can avoid the collision with pedestrian as the vehicle manage to stop from hitting the obstacle at a comfortable distance.

Keywords Autonomous Emergency Braking (AEB-P) · Artificial Potential Field (APF) path planner · Kinematic path planner · PI controller

Z. Abdullah · P. M. Heerwan (✉)
Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
e-mail: mheerwan@ump.edu.my

M. A. Zakaria
Faculty of Manufacturing and Mechatronic Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

M. I. Ishak
College of Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

I. M. Khairuddin et al. (eds.), *Enabling Industry 4.0 through Advances in Mechatronics*, Lecture Notes in Electrical Engineering 900, https://doi.org/10.1007/978-981-19-2095-0_25