Hardware-in-the-Loop Simulation and Experiment for Vehicle with ABS

蘇建彰、陳志鏗

E-mail: 9314785@mail.dyu.edu.tw

ABSTRACT

This research use a concept of Hardware-in-the-Loop tests for ABS (Anti-lock Braking System). The wheel velocity and solenoid valves control signals can be received and transferred by CAN-bus, then combines the designed seven degree of freedom vehicle dynamics model and controller to simulates the tire-ground forces act on vehicle dynamics during braking. Two controllers are designed with the feedback of slip ratio and wheel angular velocity, respectively. They are tested on dry and wet road surface to evaluate the control performance. We compare the result of commercial ECU and designed controller, then modify the parameter of the Fuzzy controller on these region to shorten the braking distance and time on various road surfaces.

Keywords : Hardware in the loop, CAN-bus, Vehicle dynamics, Fuzzy control, Anti-lock Braking System

Table of Contents

REFERENCES

[1] Wong, J. Y.,“ Theory of Ground Vehicle, ” John Wiley & Son,Third edition, 1993.

[2] Kaoru, S., Yoshiaki S.,“ Application of active yaw control to vehicle dynamics by utilizing driving/breaking force, ” JSAE Review., vol. 20, no. 2, pp. 289-295, 1999.

[3] Zanten, D. A., Erhardt, D. R., Pfaff, D. G., and Wiss, D. H.,“ ESP Electronic Stability Program, ” BOSCH, First Edition, 1999.

[4] De Koker, P. M., Gouws, J., and Pretorius, L.,“ Fuzzy Control Algorithm for Automotive Traction Control System, ” IEEE Trans. on control system technology., vol. 1, pp. 226-229, 1996.

[5] Mauer, G. F.,“ A Fuzzy Logic Controller for an ABS Braking System, ” IEEE Trans. on Fuzzy systems., vol. 3, no. 4, pp.381-388, 1995.

[6] Layne, J. R., Passino, K. M., and Yurkovich, S.,“ Fuzzy Learning Control For Anti-skid Braking System, ” IEEE Trans. on control systems technology., vol. 1, no. 2, pp.122-129, 1993.

[7] Mazumdar, S. K., and Lin, C. C.,“ Investigation of the Use of Neural Networks for Anti-Skid Brake System Design, ” Proc. of the 1995 IEEE International Symposium., pp. 505-510.

[8] Yuan, F., Puskorius, G. V., Feldkamp, L. A., and Davis, L. I.,“ Neural Network control of a Four-Wheel ABS Model, ” Proc.of the 1995

IEEE Int. Symp. on Intelligent Control., vol. 2pp.1503~1506, 1995.
[9] Cho, J. M., Hwang, D. H., Lee, K. C., Jeon, J. W., Park, D. Y., Kim, Y. J., and Joh, J. S.,“ Design and Implementation of HILS System for ABS ECU of Commercial Vehicles,” IEEE International Symposium, vol. 2, pp. 1272-1277, 2001.
[10] Teng, F. C.,“ Real-time control using Matlab Simulink,” 2000 IEEE Int. Conf. on Systems, Man, and Cybernetics., vol. 4 , pp. 2697-2702.
[11] Lee, J. C., and Suh, M. W.,“ Hardware-in-the Loop Simulator for ABS/TCS,” Proc. of the 1999 IEEE International Conference on Control Applications., pp. 652-657.
[12] Shih, M-C., and Wu, M-C.,“ Hydraulic anti-lock braking control using the hybrid sliding mode pulse width modulation pressure control method,” ImechE Proc. Instn. Mech. Engrs., vol. 215, part 1, pp. 177-187, 2001.
[13] Shih, M-C., and Wu, M-C.,“ Using the sliding-mode PWM in an anti-lock braking system,” Asian Journal of Control., vol. 3, no. 3, pp. 255-261, 2001.
[14] Shih, M-C., and Wu, M-C.,“ Simulated and experimental study of hydraulic anti-lock braking system using sliding mode PWM control,” Mechatronics., pp. 331-351, 2003.
[15] Kuang, M. L., Fodor, M., Hrovat, D., and Tran, M.,“ Hydraulic Brake System Modeling and Control For Active of Vehicle Dynamics,” Proc. of the American Control Conference., vol. 6, pp. 4538-4542, 1999.
[16] Chamaillard, Y., Gissinger, G. L., Perronne, J. M., and Renner, M.“ An original braking controller with torque sensor,” Proc. of the Third IEEE Conference on Control Applications, vol. 1, pp. 619-625, 1994.
[17] Kiencke, U., and Nielsen, L., Automotive Control Systems, Springer, 2000.
[18] 張瑞宗,“ 模糊脈寬調變控制液壓防鎖死煞車系統之研究”, 成功大學碩士論文, 1999.
[19] 李連春,“ 液壓防止鎖死剎車系統控制器設計之研究”, 成功大學碩士論文, 1997.
[20] 洪士超,“ 防鎖死煞車系統之模糊控制”, 大葉大學碩士論文,1997.
[21] 黃俊源,“ CAN-bus 應用於車輛安全控制系統之研製”, 大葉大學碩士論文, 2003.
[22] 吳金華,“ 汽車防鎖定煞車系統”, 全華科技圖書股份有限公司， 1997.
[23] 陳宗文,“ 汽車行駛動態模擬與實驗”, 大葉大學碩士論文,2003.
[24] L.A.Zadeh,“ Fuzzy Set,” Information Control Vo18,pp.338~3531965 [25] Qiao, W. Z., Mizumoto, M.,“ PID type fuzzy controller and parameter adaptive method,” Fuzzy Sets and Systems., pp.23-35 1996.