DYNAMICS SIMULATION AND CONTROL FOR VEHICLE DRIVING SYSTEM

E-mail: 9126577@ mail.dyu.edu.tw

ABSTRACT

THE THESIS IS TO DEVELOP THE DYNAMICAL EQUATION OF MOTION OF A CAR WITH SEVEN DEGREES OF FREEDOM INCLUDING THE LONGITUDINAL, LATERAL, YAW MOTION, AND ROTATIONAL MOTIONS OF FOUR WH -EELS. THE LONGITUDINAL FORCE, LATERAL FORCE AND YAW RATE ARE INVESTIGATED DURING THE VEHI -CLE CHANGING ITS DIRECTION OF CRUISE. THE SIMULATION STUDIES ARE DIVIDED INTO TWO PARTS. THE FIRST PART IS PATH FOLLOWING FOR THE DESIRED PATH. WE GENERATE THE STEERING-WHEEL ANGLES BY HUMAN BEING EXPERIENCE FOR FOLL -OWING DIFFERENT PATHS. THE SIMULATION RESULTS ARE USED AS THE TRAINING DATA FOR THE FUZZY CONTROLLER WITH ANFIS LEARNING PROCESS. THE PATH FOLLOWING FUZZY CONTROLLER IS VERIFIED BY THE COMPUTER SIMULATION. THE SECOND PART IS DYNAMIC DRIVING CONTROL (DDC). BY APPLYING THE BRAKE FORCE FOR EACH WHEEL, THE YAW MOMENTS CAN BE PRODUCED TO ADJUST TRAVELING DIRECTION OF THE VEHICLE. IT LEADS TO THE BETTER CONTROL RESULT FOR LANE CHANGE AND OBSTACLE AVOIDAN -CE IN SNOW LAND. THE FUZZY CONTROLLER CAN EFFECTIVELY FOLLOW THE PLANNED PATH ON THE DRY AND SNOW ROAD LA -ND.BY ADDING THE DYNAMIC DRIVING CONTROLLER IN THE VEHICLE, IT CAN ENHANCE ITS DRIVING CO -NTROL STABILITY ON THE SNOWY ROAD SURFACE.

Keywords: PATH FOLLOWING, ANFIS, FUZZY CONTROL, DYNAMIC DRIVING CONTROL

Table of Contents

REFERENCES

[1] S. DRAKUNOV, UMIT OZGUNER, P. DIX AND B. ASHRAFI, "ABS CONTROL USING OPTIMUM SEARCH VIA SLIDING MODES", IEEE TRANSACTION ON CONTROL SYSTEMS TECHNOLOGY, VOL.3 NO.1 MARC -H 1995.

[2] J. R. LAYNE, K. M. PASSINO, S. YURKOVICH, "FUZZY LEARNING CONTROL FOR ANTISKID BRAK -ING SYSTEM", IEEE TRANSACTION ON CONTROL SYSTEMS TECHNOLOGY, VOL.1 NO.2 JUNE 1993.

[3] F.YUAN, G. V. PUSKORIUS, L. A. FELDKAMP,AND L. I. DAVIS, "NEURAL NETWORK CONTROL OF A FOUR-WHEEL ABS MODEL",PROC. OF THE 1995 IEEE INTER. SYMP. ON INTELLIGENT CONTROL PP.1503~1506,1955.

[4] SANIAY K. MAZUMDAR,CHENG CHEW LIN, "INVESTIGATION OF THE USE OF NETWORKS FOR ANTI S -KID BRAKE SYSTEM DESIGN", IEEE 0-7803-2 722-5/95 1995.

[5] TSUNEO NAKASHIMA,"PROMOTION OF THE PROGRAM OF ADVANCED SAFETY VEHICLES FOR 21ST CEN -TURY", JSAE REVIEW, VOL.16, ISSUE: 1, JANUARY, 1995, PP. 3-6.

[6] AYUMU DOI,TETSURO BUTSURO,TADAYUKI NIIBE,TAKESHI TAKAGI,YASUNORI YAMAMOTO, HIROFUMI SENI," DEVELOPMENT OF A REAR-END COLLISION AVOIDANCE SYSTEM WITH AUTOMATIC BRAKE CO -NTROL",JSAE REVIEW, PP.335-340,FEBRUARY 1994.

[7] HEINZ LEFFLER, " CONSIDERATION OF LATERAL AND LONGITUDINAL VEHICLE STABILITY BY FUN -CTION ENHANCED BRAKE AND STABILITY CONTROL SYSTEM", SAE PAPER,NO.940832.

[8] IPL.-LNG. ALFERED PRUCKNER,DIPL.LNG MICHAEL SEEMANN, "DYNAMIC DRIVING CONTROL SYSTE -M(DDC) ON A FULL VEHICLE MODEL IN ADAMS", 1997 ADAMS USER CONFERENCE PAPERS.

[9] KAZUO TANAKA,MANABU SANO, "TRAJECTORY STABILIZATION OF A MODEL CAR VIA FUZZY CONTROL ",FUZZY SETS AND SYSTEM,VOL.70,ISSUE:2-3,MARCH 20,1995,PP.155-170.

[10] TH.FRAICHARD,PH.CARNIER, "FUZZY CONTROL TO DRIVE CAR-LIKE VEHICLES",ROBOTICS AND AUT -ONOMOUS SYSTEM,VOL:34,ISSUE:1,JANUARY 31,2001,PP.1-22.

[11] U.KIENCKE,A.DAIB, "OBSERVATION OF LATERAL VEHICLE DYNAMICS",CONTROL ENG.PRACTIVE,VOL. 5,NO.8,PP.1145-1150,1997 [12] J. M. CHO, D.H. HWANG, K.C. LEE, J.W. JEON, D.Y. PARK, Y.J. KIM AND J.S. JOH, "DESI -GN AND IMPLEMENTATION OF HILS SYSTEM FOR ABS ECU OF COMMERCIAL VEHICLES", IEEE, VOL . 2, PP.1272-1277, 2001.

[13] KAORU SAWASE,YOSHIAKI SANO, "APPLICATION OF ACTIVE YAW CONTROL TO VEHICLE DYNAMICS BY UTILIZING DRIVING/BREAKING FORCE", JSAE REVIEW VOL.20, NO.2, APRIL, 1999, PP. 289 -295.

[14] K.H ROBERT,A.M KENNETH, "ANALYSIS OF TRACTION CONTROL SYSTEMS AUGMENTED BY LIMITED SLIP DIFFERENTIALS", SAE PAPER,NO.940831.

[15] DR.-ING. ANTON VAN ZANTEN, DIPL.-ING. RAINER ERHARDT, DIPL.-ING. GEORG PFAFF, "ESP ELECTRONIC STABILITY PROGRAM", BOSCH, FIRST EDITION, 1999.

[16] J. Y. WONG, "THEORY OF GROUND VEHICLE", JOHN WILEY & SON, THIRD EDITION,1993.

[17] HENRY,J.J.,AND MEYER,W.E. , "THE SIMULATION OF THE TRACTION ON WET PAVEMENT",PROCEED -ING,XVIII INTERNATIONLER CONGRESS,FEDERATION INTERNATIONALE DES SOCIETES DINGENIEUR -S DES IECHNIQUES DE L'AUTOMOBILE,HAMBURG.,W.GERMANY,1980.

[18] WOLF-DIETER JONNER,HERMANN WINNER,LUDWIG DREILICH, "ELECTROHYDRAULIC BRAKE SYSTEM TH -E FIRST APPROACH TO BRAKE-BY-WIRE TECHNOLOGY", SAE PAPER,NO.960991.

[19] U.KIENCKE,L.NIELSEN, "AUTOMOTIVE CONTROL SYSTEMS",SPRINGER, 2000.

[20] J. L. HARNED, L. E. JOHNSTON AND G. SCHARPF, "MEASUREMENT OF TIRE BRAKE FORCE CHARAC -TERISTICS AS RELATED TO WHEEL SLIP (ANTILOCK) CONTROL SYSTEM DESIGN," SAE PAPER,NO. 69214.

[21]   ,"   ",   ,1997.

[22]   ,"   ",   ,1999.

[23]   ,   ,"   ",   ,   , 1998, P.477~ 484.

[24]   ,"   ",   ,1998.

[25]   ,"   ",   ,2000.

[26]   ,"   ",   1997.

[27]   ,   ,"   ABS   ",   ,1998.

[28]   ,"   ,"   ,PP.5-50,1993.

[29]   ,"   ",   ,1997.

[30]   ,"   ",   ,1998.

[31]   ,"A32   ",   ,1995.