MULTI-CHANNEL ACTIVE VIBRATION CONTROL IN ENGINE MOUNT ISOLATION SYSTEM

蘇富誠、吳建達

E-mail: 9126425@mail.dyu.edu.tw

ABSTRACT

THIS THESIS DESCRIBES AN ACTIVE VIBRATION CONTROL (AVC) SYSTEM FOR SINGLE-DEGREE-OF-FREE -DOM (SDOF) AND MULTIPLE-DEGREES-OF-FREEDOM (MDOF) ISOLATION PLATFORMS.THREE VARIOUS ACTIV -E VIBRATION CONTROL TECHNIQUES ARE COMPARED AND IMPLEMENTED IN TERMS OF CONTROL STRUCTURE -S AND CONTROL ALGORITHMS BY USING A FINITE-IMPULSE-RESPONSE (FIR) IN EXPERIMENTAL WORKS. THE ADAPTIVE FEEDFORWARD AND FEEDBACK CONTROL STRUCTURE USING FILTERED-X LEAST-MEAN-SQUARE (FXLMS) WITH SYNTHETIC REFERENCE IS EMPLOYED, THE LINEAR QUADRATIC GAUSSIAN (LQG) ALGORITHM WITH COMPENSATOR AND THE H-INFINITY ( ) OF ROBUST THEORY ARE APPLIED IN FEEDBACK CONTROL SYSTEM. A HYBRID CONTROLLER COMBINES THE ADAPTIVE FEEDFORWARD WITH FEEDBACK ALGORITHMS OF LQG AND TO OBTAIN THE DESIRED ROBUST PERFORMANCE AND FAST CONVERGENCE IS PROPOSED. TWO CONTROL PLANT CONFIGURATIONS ARE IDENTIFIED BY A FREQUENCY-DOMAIN TECHNIQUE AND IMPLEMENTED BY USING A TMS320C32 DIGITAL SIGNAL PROCESSOR (DSP). EXPERIMENTS ARE CARRIED OUT TO EVALUATE THE PROPOSED SYSTEM FOR REDUCING THE VIBRATION OF ISOLATION PLATFORM AT VARIOUS CONTROL CONDITIONS. THE COMPARISON OF THREE CONTROL STRUCTURES AND THREE ALGORITHMS FOR TWO ISOLATION PLATFORMS IS ALSO DESCRIBED IN THIS THESIS.

Keywords : ACTIVE VIBRATION CONTROL, ENGINE MOUNT SYSTEM, FINITE-IMPULSE-RESPONSE, DIGITAL SIGNAL PRO -CESSOR

Table of Contents

REFERENCES

1.R. L. CLARK AND D. S. BERNSTEIN, 1998, "HYBRID CONTROL: SEPARATION IN DESIGN," JOURNAL OF SOUND AND VIBRATION, VOL. 214, PP. 784-791. 2.A. M. BEARD, D. W. SCHUBERT AND A. H. FLOTOW, 1994, "A PRACTICAL PRODUCT IMPLEMENTATION OF AN ACTIVE/ PASSIVE VIBRATION ISOLATION SYSTEM," ASME JOURNAL OF VIBRATION AND ACOUST -ICS, VOL. 75, PP. 485-492. 3.L. R. MILLER, M. AHMADIAN,C. M. NOBLES AND D. A. SWANSON 1995,"MODELING AND PERFORMANCE OF AN EXPERIMENTAL ACTIVE VIBRATION ISOLATOR," ASME JOURNAL OF VIBRATION AND ACOUSTICS, VOL. 117, PP. 272-278. 4.C. R. FULLER, S. J. ELLIOTT AND P. A. NELSON,1997,ACTIVE CONTROL OF VIBRATION,SAN DIEGO :HARCOURT-BRACE. 5.S. M. KUO AND D. R. MORGAN,1996, ACTIVE NOISE CONTROL SYSTEMS: ALGORITHMS AND DSP IMPLE -MENTATIONS, NEW YORK: JOHN WILEY AND SONS. 6.J. S. VIPPERMAN,R. A. BURDISSO

AND C. R. FULLER, 1993,"ACTIVE CONTROL OF BROADBAND STRU -CTURAL VIBRATION USING THE LMS ADAPTIVE ALGORITHM," JOURNAL OF SOUND AND VIBRATION,VOL .166, PP. 283-299. 7.Y. OKADA, H. HARADA AND K. SUZUKI,1997,"ACTIVE AND REGENERATIVE CONTROL OF AN ELECTRODY -NAMIC TYPE SUSPENSION," JSME JOURNAL SERIES C., VOL. 40, PP. 272-278. 8.D. KARNOPP, 1995, "ACTIVE AND SEMI-ACTIVE VIBRATION ISOLATION," ASME SPECIAL ISSUE,VOL. 117, PP. 177-185. 9.Z. NAKAJIMA AND A. ICHIKAWA, 1995, "ACTIVE ENGINE MOUNT FOR LARGE AMPLITUDE OF IDLING VIBRATION," SAE PAPER NO.951298. 10.M. R. JOLLY AND D. L. MARGOLIS, 1997, "REGENERATIVE SYSTEMS FOR VIBRATION CONTROL,"ASME JOURNAL OF VIBRATION AND ACOUSTICS, VOL. 119, PP. 208-215. 11.J. D. WU AND M. R. BAI, 2001, "APPLICATION OF FEEDFORWARD ADAPTIVE ACTIVE NOISE CONTROL FOR REDUCING BLADE PASSING NOISE IN CENTRIFUGAL FANS," JOURNAL OF SOUND AND VIBRATION, VOL. 239, PP. 1051-1062. 12.R. H.CABELL AND C.R.FULLER,1999,"A PRINCIPAL COMPONENT ALGORITHM FOR FEEDFORWARD ACTIVE NOISE AND VIBRATION CONTROL," JOURNAL OF SOUND AND VIBRATION, VOL. 227, PP. 159-181. 13.A. KRISHNAN AND M.DAS,2000,"MINIMUM VARIANCE & LQG CONTROL FOR ACTIVE NOISE CANCELING-A COMPARISON," PROC. 43RD IEEE CONF. MIDWEST SYMP. ON CIRCUITS AND SYSTEM PP. 1358-1361. 14.M. BAI AND H. CHEN, 1996, "A MODIFIED H2 FEEDFORWARD ACTIVE CONTROL SYSTEM FOR SUPPRESS -ING BROADBAND AND TRANSIENT NOISES," JOURNAL OF SOUND AND VIBRATION, VOL.198,PP.81-94. 15.C. E. LIN AND Y. R. SHEU,1992,"A HYBRID-CONTROL APPROACH FOR PENDULUM-CAR CONTROL,"IEEE TRANSACTIONS ON CONTROL SYSTEM INDUSTRIAL ELECTRONICS VOL. 39, PP. 208-214. 16.Y. H. LIU, K. KITAGAKI, T. OGASAWARA AND S. ARIMOTO, 1999, "MODEL-BASED ADAPTIVE HYBRID CONTROL FOR MANIPULATORS UNDER MULTIPLE GEOMETRIC CONSTRAINTS," IEEE TRANSACTIONS ON CO -NTROL SYSTEMS TECHNOLOGY,VOL. 7, PP. 97-109. 17.W. YU , T. CHAI AND Y. YUAN, 1996, "DECREASED VIBRATION CONTROL FOR CENTRIFUGES: A NEW ADAPTIVE HYBRID CONTROL TECHNIQUE," CONTROL ENGINEERING PRACTICE, VOL.4, PP. 1693-1700. 18.J. YANG, Y. SUEMATSU AND Z. KANG, 2001, "TWO-DEGREE-OF-FREEDOM CONTROLLER TO REDUCE THE VIBRATION OF VEHICLE ENGINE-BODY SYSTEM," IEEE TRANSACTIONS ON CONTROL SYSTEM TECHNOLOGY, VOL. 9, PP. 295-304. 19.J. M. MACIEJOWSKI, 1990, MULTIVARIABLE FEEDBACK DESIGN, NEW YORK: ADDISON-WESLEY. 20.S. SKOGESTAD AND I. POSTLETHWAITE, 1996, MULTIVARIABLE FEEDBACK CONTROL,NEW YORK: JOHN WILEY AND SONS. 21.R. H. MIDDLETON AND G. C. GOODWIN,1990,DIGITAL CONTROL AND ESTIMATION, NEW JERSEY:PRENT ICE HALL. 22.M. R. BAI AND W. LUO,2000,"DSP IMPLEMENTATION OF AN ACTIVE BEARING MOUNT FOR ROTORS USI -NG HYBRID CONTROL," ASME JOURNAL OF VIBRATION AND ACOUSTICS, VOL. 122, PP. 420-428. 23.W. K. TSENG, B. RAFAELY AND S. J. ELLIOTT, 1998, "COMBINED FEEDBACK-FEEDFORWARD ACTIVE CONTROL OF SOUND IN A ROOM," JOURNAL OF ACOUSTICAL SOCIETY OF AMERICA,VOL. 104, PP.3417 -3425.