引擎排氣系統之主動式噪音控制

李天華、吳建達

E-mail: 9126429@mail.dyu.edu.tw

摘 要

本論文主要是描述利用主動式噪音控制技術來實現引擎排氣系統之管路噪音控制，以提高車輛之駕駛舒 適性。在控制法則上採用有限脈衝響應濾波器來設計可變收斂係數之適應性演算法與調變增益之固定式 控制器，並利用數位信號處理器來實現即時控制。在控制架構中，聲學回授效應經常會造成控制系統的 不穩定性，因此在控制器的設計上將納入聲學回授效應的影響，並採用有方向性的麥克風與向後式之控 制喇叭以更有效降低此影響。研究中首先以人工合成音源、鼓風機噪音為研究方向，進而考慮具有溫度 影響之引擎排氣系統之週期性多頻噪音。在訊號擷取上採用聲學感知器(麥克風)與非聲學感知器(光學式 轉速計)量測參考訊號。本論文將評估此二種控制架構實現於不同的噪音源控制系統上，實驗的結果顯示 主動式噪音控制系統可有效的降低人工合成音源之寬頻噪音、風扇噪音與引擎排氣系統所產生的週期性 多頻噪音。

關鍵詞 : 主動式噪音控制，數位信號處理器，聲學回授，引擎排氣系統

目錄

參考文獻

1 M. L. MUNJAL,1986,ACOUSTICS OF DUCTS AND MUFFLERS WITH APPLICATION TO EXHAUST AND VENTI -LATION SYSTEM DESIGN, NEW YORK: JOHN WILEY AND SONS. 2 L. HUANG, 2000, "A THEORY OF REACTIVE CONTROL OF LOW-FREQUENCY DUCT NOISE," JOURNAL OF SOUND AND VIBRATION, VOL. 238, PP. 575-594. 3 A. SELAMET AND Z. L. JI, 2000, "ACOUSTIC ATTENUATION PERFORMANCE OF EXPANSION CHAMBERS WITH TWO END-INLETS/ONE SIDE-OUTLET," JOURNAL OF SOUND AND VIBRATION, VOL. 231 , PP. 1159-1167. 4 A. CUMMINGS, 1999, "HIGH FREQUENCY RAY ACOUSTICS MODELS FOR DUCT SILENCERS," JOURNAL OF SOUND AND VIBRATION, VOL. 221, PP. 681-708. 5 P. LUEG, 1936, PROCESS OF SILENCING SOUND OSCILLATIONS, U.S. PATENT NO. 2043416. 6 M. J. LIGHTHILL, 1952, "ON SOUND GENERATED AERODYNAMICALLY. I. GENERAL THEORY," PROCEED -INGS OF THE ROYAL SOCIETY OF LONDON, VOL. A211, PP. 564-578. 7 S. M. KUO AND D. R. MORGAN, 1996, ACTIVE NOISE CONTROL SYSTEMS: ALGORITHMS AND DSP IMPL -EMENTATIONS, NEW YORK: JOHN WILEY AND SONS. 8 P. A. NELSON AND S. J. ELLIOT, 1992, ACTIVE CONTROL OF SOUND, LONDON: ACADEMIC PRESS. 9 R. F. FONTAINE LA AND I. C. SHEPHERD,1983, "AN EXPERIMENTAL STUDY OF A BROADBAND ACTIVE ATTENUATOR FOR CANCELLATION OF RANDOM NOISE IN DUCTS," JOURNAL OF SOUND AND VIBRATION, VOL. 91, PP. 351-362. 10 J. C. DOYLE AND B. A. FRANCIS, 1992, FEEDBACK CONTROL THEORY,NEW YORK:MACMILLAN PUBLISH -ING COMPANY. 11 M. T. S. TOMIZUKA AND K. K. CHEW, 1989,"ANALYSIS AND SYNTHESIS OF DISCRETE-TIME REPETI -TIVE CONTROLLERS," ASME JOURNAL OF DYNAMIC SYSTEMS, MEASUREMENT, AND CONTROL,VOL. 111, PP. 353-358. 12 M. R. BAI AND H. LIN, 1998, "PLANT UNCERTAINTY ANALYSIS IN A DUCT ACTIVE NOISE CONTROL PROBLEM BY USING THE THEORY," JOURNAL OF ACOUSTICAL SOCIETY OF AMERICA, VOL. 104, PP. 237-247. 13

M. L. MUNJAL AND L. J. ERIKSSON, 1988, "AN ANALYTICAL, ONE-DIMENSIONAL, STANDING-WAVE MODEL OF A LINEAR ACTIVE NOISE CONTROL SYSTEM IN A DUCT," JOURNAL OF ACOUSTICAL SOCIETY OF AMERICA, VOL. 84, PP. 1086-1093. 14 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. 15 M. R. BAI AND D. J. LEE, 1997, "IMPLEMENTATION OF AN ACTIVE HEADSET BY USING THE ROBUST CONTROL THEORY," JOURNAL OF ACOUSTIC SOCIETY OF AMERICA, VOL. 102, PP. 2184-2190. 16 R. L. CLARK AND D. S. BERNSTEIN, 1998, "HYBRID CONTROL: SEPARATION IN DESIGN," JOURNAL OF SOUND AND VIBRATION, VOL. 214, PP. 784-791. 17 J. HONG AND D. S. BERNSTEIN, 1998, "BODE INTEGRAL CONSTRAINTS,COLLOCATION,AND SPILLOVER IN ACTIVE NOISE AND VIBRATION CONTROL," IEEE TRANSACTIONS ON CONTROL SYSTEM TECHNOLOGY, VOL. 6, PP. 111-120. 18 D. G. MAC MARTIN AND S. R. HALL, 1991, "STRUCTURAL CONTROL EXPERIMENTS USING AND POWER FLOW APPROACH," JOURNAL OF SOUND AND VIBRATION, VOL. 148, PP. 223- 241. 19 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. 20 A. ROURE, 1985, "SELF ADAPTIVE BROADBAND ACTIVE SOUND CONTROL SYSTEM," JOURNAL OF SOUND AND VIBRATION, VOL. 101, PP. 429-441. 21 J. D. WU AND M. R. BAI, 2001, "DEVELOPMENT OF A ZERO SPILLOVER CONTROLLER FOR BROADBAND CANCELLATION OF NOISE IN DUCTS," JAPANESE JOURNAL OF APPLIED PHYSICS, VOL. 40, PP.6634 -6640.