

引擎正時鏈條系統之動態特性分析研究

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摘要

引擎之閥系統主要控制汽缸各閥之開關時序，為引擎性能之主要關鍵控制因素之一，閥系統由凸輪軸帶動。引擎由曲柄軸轉動，經由皮帶或鏈條帶動凸輪軸，此即為正時皮帶系統或正時鏈條系統。本研究的目的在於正時鏈條之動態分析研究，瞭解正時鏈條系統在不同轉速下之共振頻率變化的狀況。在本研究中，將包含建立分析鏈條動態的數學模型，以及建立鏈條之動態實驗平台，並協助合作廠商建立引擎之正時鏈條系統相關之技術能力。

關鍵詞：正時鏈條系統，系統動態分析，共振頻率

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參考文獻

- [1] <http://www.audi.com.de>, 引擎技術手冊, 德文版
- [2] W.T.Rim and K.J.Kim, “ Identification of Tension in a Belt-Driven System by Analyzing Flexural Vibrations ” Mechanical Systems and Signal Processing, Vol.8, No.2, pp.199-213, 1994.
- [3] J.C. Conwell and G.E. Johnson, “ Experimental Investigation of Link Tension and Roller-Sprocket Impact in Roller Chain Drives, ” Mechanism and Machine Theory, Vol.31, No.4, pp.533-544, 1995.
- [4] K.H.Low, “ Computer-Aided Selection of Roller Chain Drives, ” Computers and Structures, Vol.55, No.5, pp.925-936, 1995.
- [5] Rong-Fong Fung and Cheng-Chan Liao, “ Application of Variable Structure Control in the Nonlinear String System, ” Journal of Mechanics and Sciences, Vol.37, No.9, pp.985-933, 1995.
- [6] S.P. Liu and K.W. Wang, “ A Global-Local Integrated Study of Roller Chain Meshing Dynamics, ” Journal of Sound and Vibration, Vol. 203, Issue: 1, pp.41-62, 1997.
- [7] J. Moon and J.A. Wickert, “ Non-Linear Vibration of Power Transmission Belts, ” Journal of Sound and Vibration, Vol. 200, Issue: 4, pp.419-431, 1997.
- [8] L. Zhang and J.W. Zu, “ Non-Linear Vibrations of Viscoelastic Moving Belts, Part :Free Vibration Analysis, ” Journal of Sound and

- Vibration, Vol.216, No.1, pp.75-91, 1998.
- [9] Y.I. Kwon and J.G. Ih, " Vibrational Power Flow in the Moving Belt Passing Through a Tensioner, " Journal of Sound and Vibration, Vol. 229, Issue: 2, pp.329-353, 2000.
- [10] C.A. Tan and S. Ying, " Active Wave Control of the Axially Moving String: Theory and Experiment, " Journal of Sound and Vibration, Vol. 236, Issue: 5, pp.861-880, 2000.
- [11] Tetsuya Hyakutake and Mitsuo Inagaki, " Measurement of friction in timing chain, " JSME Review, Vol.22, pp.343-347, 2001.
- [12] J. Chung and C.S. Han, " Vibration of an axially Moving String With Geometric Non-Linearity and Translating Acceleration, " Journal of Sound and Vibration, Vol.240, Issue:4, pp.733-746, 2001.
- [13] S.E. Khadem and M. Rezaee, " Non-Linear Free Vibration Analysis of a String Under Bending Moment Effects Using the Perturbation Method, " Journal of Sound and Vibration, Vol.254, Issue:4, pp.677-691, 2002.
- [14] C. Shin, W. Kim and J. Chung, " Free In-Plane Vibration of an Axially Moving Membrane, " Journal of Sound and Vibration, Vol.272, pp.137-154, 2004.
- [15] G. Suweken, " A Mathematical Analysis of a Belt System with a Low and Time-Varying Velocity " Master of Mathematical Sciences, University of Adelaide, South Australia, 2003.
- [16] 洪文駿, " 反齒形鏈條傳動系統片形變化效應模擬分析, " 中興大學碩士論文, 2004.
- [17] Makoto Kanehira, " The Complete Guide to Chain, " U.S.Tsubaki, Inc., 1997.
- [18] http://www.renold.com/Renold/Web/Site/Support/Catalogue_Download/Chain_Catalogues.asp, 2004.
- [19] www.diamondchain.com [20] <http://www.sqchain.com.cn/cpk2.htm> [21] http://www.thc.cn/transmission_drive_chain/silent_chains.htm
- [22] J. Shigley, C. Mischke, " Standard Handbook of Machine Design 2nd Edition, " McGraw-Hill, CH 32, pp.1-32, 1996.
- [23] Model SR785 Operating Manual , Stanford Research Systems Inc., 2001.
- [24] L. Zhang and J.W. Zu, " Non-Linear Vibrations of Viscoelastic Moving Belts, Part :Forced Vibration Analysis, " Journal of Sound and Vibration, Vol.216, Issue: 1, pp.93-105, 1998.
- [25] G. Suweken and W.T VAN Horssen, " On the Transversal Vibrations of a Conveyor Belt with a Low and Time-Varying Velocity. Part :The String-Like Case, " Journal of Sound and Vibration, Vol.264, pp.117-133, 2003.
- [26] E. Ozkaya and M. Pakdemirli, " Lie Group Theory and Analytical Solutions for the Axially Accelerating String Problem, " Journal of Sound and Vibration, Vol.230, Issue:4, pp.729-742, 2000.
- [27] Leonard Meirovitch, " Fundamentals of Vibrations, " McGraw-Hill International Edition, 2001.
- [28] H. Koivurova, " Dynamic Behaviour of an Axially MovingMembrane Interacting with the Surrounding Air and Making Contact with Supporting Structures, " Department of Mechanical Engineering, University of Oulu, 1998 [29] R.O. Parmley, " Illustrated Sourcebook of Mechanical Components, " McGraw-Hill Professional, Section 2, pp.2-3, 1985.