

Accepted Manuscript

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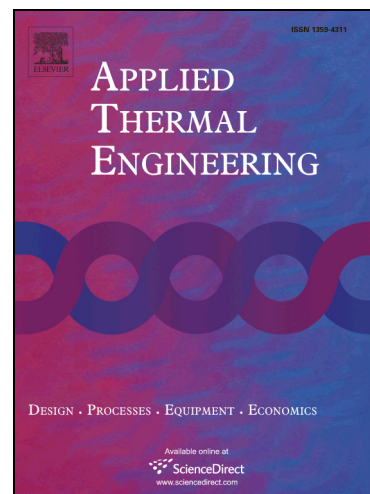
PII: S1359-4311(17)30625-7
DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2017.04.109>
Reference: ATE 10258

To appear in: *Applied Thermal Engineering*

Received Date: 28 January 2017
Revised Date: 26 March 2017
Accepted Date: 24 April 2017

Please cite this article as: S-L. Ding, E-Z. Song, L-P. Yang, G. Litak, Y-Y. Wang, C. Yao, X-Z. Ma, Analysis of chaos in the combustion process of premixed natural gas engine, *Applied Thermal Engineering* (2017), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2017.04.109>

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Analysis of chaos in the combustion process of premixed natural gas engine

Shun-Liang Ding^a, En-Zhe Song^{a,*}, Li-Ping Yang^a, Grzegorz Litak^{b,c}, Yu-Yuan Wang^a, Chong, Yao^a, Xiu-Zhen Ma^a

^a College of Power and Energy Engineering, Harbin Engineering University, Harbin 150001, China

^b Faculty of Mechanical Engineering, Lublin University of Technology, Lublin PL-20-807, Poland

^c Department of Process Control, AGH University of Science and Technology, Cracow PL-30-059, Poland

ABSTRACT: In this paper, the dynamical characteristics of a combustion process in the premixed natural gas engine are studied with the phase space reconstruction method and the 0-1 test method. To express the influence of the system parameters the experiments are carried out under different injection timing conditions. The results express that by reconstructing the phase space, the patterns of combustion process can be clearly investigated. The attractors of in-cylinder pressure, $IMEP$, Q and θ_{50} time series exhibit more serious variations when the injection timing is $45^\circ CA \sim 60^\circ CA$. The normalized time series is proposed to be used in the coordinates of the 0-1 test. In the results we obtained the characteristic values of the control parameter, K , is close to 0 for a motored engine and 1 for all the cases with different injection timings. Moreover, with increasing of the injection timing, the K value firstly increase and then decrease. The results demonstrate that the combustion process of a premixed natural gas engine under different injection timing conditions is considered to be chaotic. Furthermore, the chaotic behavior is stronger under $45^\circ CA \sim 60^\circ CA$ injection timing conditions. This coincides with the phase space reconstruction results.

Keywords: Natural gas engine, Combustion process, Chaos, 0-1 test, Time series analysis

1. Introduction

In recent years, oil shortages and environment pollution have become two major challenges

* Corresponding author. Email: sez2005@sina.com , dingshunliang@126.com

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