Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **14 (2007)** 123-134

CHAOTIC OSCILLATIONS OF A NONLINEAR TWO DEGREES OF FREEDOM SYSTEM WITH AIR SPRINGS

Qin Zhu[1] and Mitsuaki Ishitobi[2]

[1] Department of Mechanical Engineering
Oyama National College of Technology, Oyama 323-0806, Japan
Email: zhu@oyama-ct.ac.jp

[2]Graduate School of Science and Technology
Kumamoto University, Kumamoto 860-8555, Japan

Abstract. The chaotic motion in a harmonically forced two-degree-of-freedom system is investigated both experimentally and numerically. Numerical simulations show that the system exhibits periodic motions, quasiperiodic motions and chaotic motions. The experiments confirm that the chaotic response exists. The results indicate that chaotic response needs to be considered when air spring is introduced to the system.

Keywords. Nonlinear oscillations, Bifurcation, Chaos, Air spring.

AMS (MOS) subject classification: 34C15, 70K40, 74H45.

1 Introduction

The two-degree-of-freedom spring-damper system subjected to harmonic excitation is often used in the study of dynamic behavior of vibration absorber [1]. It is also an important mechanical model for investigating the heave motion of ground vehicle [2]. Many researchers have introduced the nonlinear springs to the model since the steady state response of the absorber or the performance of suspension of the vehicle can be improved. However, the presence of the nonlinearities may also cause the chaotic responses which could be harmful to the system. Půst and Szöllös investigated the system with linear and nonlinear springs and found that there existed several new bifurcations and instability domains, in which the response is chaotic [3]. Zhu et al. applied the method of averaging to investigate stability of nonlinear dynamic vibration absorbers and pointed out that chaotic vibration would be likely to occur due to the presence of the non-linearities [4]. These studies are based on theoretical analysis of the system with approximation.

The present investigation is to study the nonlinear dynamic behavior of a two-degree-of-freedom vibration system with air springs. Since air is a compressible cushioning medium, air spring has capability of excellent reduction of vibration and it is a stabilizing alternative to steel springs. However, since