Integrated design of radial active magnetic bearing systems using genetic algorithms

Hada Chang, Sung-Chong Chung *

Department of Mechanical Design and Production Engineering, Hanyang University, 17 Haengdang-Dong, Sungdong-Gu, Seoul 133-791, South Korea

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Abstract

Performance of active magnetic bearing (AMB) systems depends upon the size, the controller and the power amplifier. To design optimal AMB systems with good stiffness, damping and stability, simultaneous consideration on the AMB itself and characteristics of the controller and the power amplifier should be required in design processes. In this paper, an integrated design methodology is introduced to design a radial AMB system of which volume is minimized according to given design specifications such as static and dynamic load carrying capacities and the equivalent stiffness. Through the dynamic modeling of the radial AMB system, a nonlinear constrained optimization problem is formulated from the design process. To obtain an optimal design result, genetic algorithm (GA) is used as an optimization tool. A self-normalizing method is developed to eliminate the requirement of initial design process for normalization and improve diversity of the solution. Validity of the proposed design method is verified by comparing the result with that of the previous study, where the integrated design methodology and the GA were not used. © 2001 Elsevier Science Ltd. All rights reserved.

1. Introduction

A radial active magnetic bearing (AMB) system supports a rotor without any mechanical contact by electrically controlling the electromagnetic force. Since the rotor is floated in the air gap, the AMB can get rid of the mechanical breakdown caused by wear or friction and there is no need for lubrication and sealing. In addition, an AMB system can be designed so that it has adjustable stiffness and damping. Therefore, a high-speed and high-precision rotating motion can be

*Corresponding author. Tel.: +82-2-2290-0444; fax: +82-2-2298-4634.
E-mail address: schung@email.hanyang.ac.kr (S.-C. Chung).