Advanced Design and Manufacturing Technology IV

Part 3

Edited by
Jianzhong Lin, Tianhong Yan,
Xinsheng Xu and Zhengyi Jiang

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Advanced Design and Manufacturing Technology IV

PART 3

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Edited by

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Preface

The international conference on advanced design and manufacturing engineering series provides a forum for accessing to the most up-to-date and authoritative knowledge from both industrial and academic worlds, sharing best practice in the field of advanced design and manufacturing engineering. The meeting will provide an opportunity to highlight recent developments and to identify emerging and future areas of growth in this exciting field. The first of this conference series (ADME 2011) was held in Guangzhou, China, in September 2011 with the participation of Scientists from the Asia-Pacific region, Europe and the United States. The second of this conference series (ADME 2012) was held in Taiyuan, China, in August 2012 and the third one was held in Anshan (ADME 2013), China, in July 2013. Following the success of the previous conferences, the 4th International Conference on Advanced Design and Manufacturing Engineering (ADME 2014) was taken place in Hangzhou, China, From July 26 to 27, 2014. This conference successfully brought together scientists and engineers from industry and academia and provided a forum for exchange of ideas, cooperation and future directions by means of keynote speeches, regular presentations and a round-table discussion.

All papers had undergone the careful peer-review by expert referees to the professional and scientific standards before it is selected for publications in those volumes. Studies presented in this book cover these topics: Structural Dynamic Analysis, Optimization and Control, Heat, Fluid and Flow Engineering, Thermodynamics Manufacturing Applications, Advanced Design and Systems Dynamics, Mechanical Strength, Reliability, Risk Analysis and Assessment, CAD / CAM / CAE, Advanced Manufacturing and Industry Engineering, Manufacturing Production, Operations, Quality and Control, Green Supply Chain and the Internet of Things Development, Mechatronics, Industrial Robots, Automation and Control Technologies, Machine Vision Technology, Image and Video Processing, Measurement Technology, Instruments and Sensors, Detection Technologies and Methodologies, Embedded Systems and Modern Electronic, Circuit Technology, Electric, Electromagnetic and Power Engineering Applications, Computer Applications and Mathematical Modeling, Intelligent Algorithms and Optimization, Industrial Engineering and Systems Engineering, Engineering Education and Engineering Management.

We believe that this conference provided a medium for scientists and experts in the field to effectively communicate and share ideas. We would like to express our sincere thanks to all participants for their contributions and stimulating discussions. We are also grateful to keynote speakers, referees, exhibitors, committee members and many others for their patience and efforts.

The Organizing Committee of ADME 2014

The 4th International Conference on

Advanced Design and Manufacturing Engineering

(ADME 2014)

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Researches on PID Controller Parameters Optimization Using IWO

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Keywords: giant magnetostrictive actuator; pid control; invasive weed optimization(IWO)

Abstract. In low frequencies, based on the linear model of giant magnetostrictive actuator, the PID controller is designed. According to the situation of fixed parameter controller with weak adaptive capacity, an intelligent algorithm - Invasive Weed Optimization (IWO) with competition mechanism is introduced to optimize the PID controller parameters. Invasive Weeds Optimization can elect adaptable seeds as optimal parameters through reproduction, spatial distribution and survival of the fittest. It has strong global and local search capability, which can effectively improve the control robustness and position tracking accuracy. Simulation results show that: for the step signal, compared with the traditional PID control, weed control PID control has the characteristics of high precision, good tracking performance and strong noise suppression capability.

Introduction

Currently, PID controller is widely used in industrial control. But the feedback control PID, which is based on the effect of poor error, will be not useful for the complex controlled object with a high order number and bad system parameter instability. The feedforward control can be timely following instructions, there is no phenomenon of delay and closed-loop instability. So the control combined with feedback and feedforward can bring a better result. While it still has the shortcomings poor robustness for its fixed parameters. With the development of some intelligent optimization algorithms, genetic and particle swarm algorithm have been applied in the parameter optimization of the controller [1-2]. Invasive Weed Optimization-IWO is a simple and effective population intelligent optimization algorithm which is proposed recently. It was first proposed by the Mehrabian and Lucus to solve numerical optimization problems [3]. Since proposed, IWO has been applied to solve many optimization problems in the continuous function for its robustness, adaptability and randomness, and attracted widespread attention [4-6]. Mallahzadch and Yousefi-Koma used IWO algorithm to solve the optimization problem of the piezoelectric actuators on the aircraft tail fin and the optimization result reduced the shock exciter effectively [7-8]. S H Sedighv used the IWO algorithm to optimize the structure of the printed Yagi antennas. After the optimization, a higher gain and a small VSWR in the same frequency band was obtained than the earlier findings of the antenna [9]. The algorithm weeds (IWO) is applied to optimize the three parameters dynamically giant magnetostrictive actuator PID controller in this paper. The simulation result shows that the algorithm can adjust the PID controller parameters to the time.

The mathematical model of giant magnetostrictive actuator

The schematic diagram of giant magnetostrictive actuator (GMA) is shown in Fig.1, it is mainly composed of the magnetostrictive rod, driven magnetic field and bias magnetic field etc. In lower frequencies, the actuator dynamic characteristics can be described as a linear system by ignoring eddy current losses. According to Kirchhoff's law and magnetic field theory: