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CPG-BASED LOCOMOTION CONTROL OF A ROBOTIC FISH: USING LINEAR OSCILLATORS AND REDUCING CONTROL PARAMETERS VIA PSO

Chen Wang[1,2], Guangming Xie[1,3], Long Wang[1] and Ming Cao[2]

[1]State Key Laboratory of Turbulence and Complex Systems
Intelligent Control Laboratory
Center for Systems and Control
College of Engineering
Peking University
No. 5, Yiheyuan Road, Haidian District, Beijing 100871, P. R. China
{ wangchen; xiegming; longwang }@pku.edu.cn

[2]Faculty of Mathematics and Natural Sciences, ITM
University of Groningen
Nijenborgh 4, 9747 AG Groningen, The Netherlands
{ chen.wang; m.cao }@rug.nl

[3]School of Electrical and Electronics Engineering
East China Jiaotong University
Changbei Developing Zone, Nanchang 330013, P. R. China

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Abstract. *The aim of the present study is to investigate the locomotion control of a robotic fish. To achieve this goal, we design a control architecture based on a novel central pattern generator (CPG) and implement it as a system of coupled linear oscillators. This design differs significantly from the usual CPG models in which nonlinear oscillators are commonly used. While our CPG keeps all the basic features of its biological counterparts and is capable of producing coordinated patterns of rhythmic activity, thanks to the linearity of the oscillators used, the computational costs of the CPG are greatly reduced and all the structural parameters can be selected easily. In addition to the proposed CPG model, the complete control architecture in our study also contains a transition layer, which is used to transform higher level control commands into accessible inputs to the CPG. Moreover, particle swarm optimization (PSO) is implemented to reduce the control parameters. As a result, as few as two control parameters, including the frequency for speed control and the offset of the motors for direction control, are sufficient for the whole locomotion control implementation. Additionally, a transition layer makes the locomotion control implementation simple and straightforward. Results from both simulation and experiment demonstrate the efficiency of the proposed CPG-based locomotion control approach.*

Keywords: Robotic fish, Locomotion control, Central pattern generator (CPG), Particle swarm optimization (PSO), Linear oscillator, Transition layer

1. **Introduction.** Organisms have probably existed in the world for hundreds of millions of years. Their perfect physical structures and excellent locomotion properties emerging from the continuous long-period evolution fascinate all researchers who hope to design better mobile robots. Recent developments in bionics, materials, computation, electronics and fabrication technologies offer researchers an unprecedented opportunity to design novel mobile robots based on inspiration from animals.