北京工业大学

Conditioning Learning Model based on BP Network

Abstract. The naissance of cognitive robotics marks that psychology is more and more highly involved in the artificial intelligence research. Inspired by psychology and ethology, we propose an operant conditioning learning model based on BP (back-propagation) network named *OCLMBP* on the basis of Skinner's relevant theory. The model is applied to the problem of obstacle avoidance with a wheeled robot. The robot controlled by the model can learn to avoid obstacles through a learning-by-doing style without any external supervision, but by the proximity sensors information as positive or negative reinforcement signals. The results are compared with original *OCLM* (operant conditioning learning model), and the proposed model has better performance.

Keywords: Operant conditioning, BP network, obstacle avoidance, cognitive robotics

基于BP网络自主调节学习模型

摘 要：认知性机器人的诞生让心理学更加注重人工智能的研究。受心理学和个体生态学的启发，我们提出了一个基于BP网络自主调节学习模型，基于Sinner的相关理论，我们把它命名为OCLMBP。这个模型应用于轮式机器人的避障问题。通过该模型的控制，机器人通过自身周围传感器传输的正或负的辅助信号，可以一边学习一边自主避障。结果和OCLM(operant conditioning learning model 自主调节学习模型)信号进行比对，数据显示这个模型有很好的效果。

关键词：自主，BP网络，避障，轮式机器人

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Operant Conditioning Learning Model in the Bionic Experiment

Abstract.A learning model based on the operant conditioning mechanism (OCLM) is presented in this paper to deal with the autonomous learning problem in cognitive robotics. The model is described by 9 elements, including the space set, the action set, the bionic learning function and the system entropy etc. To describe the learning mechanism which is the core of the model, a new notion "negative ideal degree"(NID) is defined. We also prove the convergence of OCLM to indicate that the model is a self-organization system. OCLM has been applied to simulating the Skinner rat experiment. The results show that this model can well simulate the animal's operant conditioning behavior, acquire the cognitive skills through the interaction with the environment and achieve self-learning and self-adaptability.

Keywords: Operant Conditioning Learning Model, Skinner Rat Experiment, Autonomous Learning,Cognitive Robotics

自主学习模型的仿真实验

摘 要：本论文提出的是一个基于自主的学习模型，来解决认知型机器人自主学习的问题。本模型通过9个元素来描述，包括空间设置，动作设置，仿真功能和系统熵等。为了去描述模型的核心原理，我们定义了一个新的概念"负理想度"(NID)。我们也证明OCLM的复模糊数指出这个模型是一个自主型系统。OCLM被应用于模拟Skinner小鼠实验。结果表明这个模型可以很好地模仿动物的自主学习行为，通过对环境交互获得认知本领和自我适应的能力。

关键词：自主学习模型，Skinner小鼠实验，自动学习认知型机器人

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Study on Forward-Facing Model and Real-Time Simulation for a Series Hybrid Electric Vehicle

Abstract: To shorten design period and reduce development costs, computer modeling and simulation is important for HEV design and development. In this paper, real-time simulation for a Series Hybrid Electric Vehicle (SHEV) is made to verify its fuzzy logic control strategy based on dSPACE-DS1103 development kits.The whole real-time simulation schematic is designed and the vehicle forward-facing simulation model is set up. Modeling methods for the driver, controller and vehicle (includes engine, generator, motor, battery, etc.)under MATLAB/Simulink environment are discussed in detail. Driver behavior is simulated by two potentiometers and introduced into the real-time system to realize close-loop control. A real-time monitoring interface is also developed to observe the experiment results. Experiment results show that the real-time simulation platform works well and the SHEV fuzzy logic control strategy is effective.

Keywords: Control strategy, forward-facing, modeling, real-time simulation, series hybrid electric vehicle

混合动力系列汽车在前向模型学习和实时仿真

摘 要：为了缩短设计时间并减少开发成本，电脑建模和仿真对于 HEV 设计和发展非常重要。在这篇论文里，为混合动力系列汽车(SHEV)实时仿真是基于 dSPACE-DS1103 开发工具，验证其模糊逻辑控制策略。设计出了整个实时仿真原理图、建立了车辆仿真模型。为司机、管理员和车辆（包括引擎、发电机、发动机、电池等）在 MATLAB/Simulink 环境下详细地讨论仿真。司机的行为被两个电位器并引入实时系统实现循环控制。实时监控画面可以观察实验结果。实验结果表明实时仿真平台工作出色且 SHEV 模糊逻辑控制策略有效。

关键词：控制策略，前向的，建模，实时仿真，混合动力系列

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Design and Simulation of Fuzzy Logic Control Strategy for an SHEV

Abstract. A control strategy based on fuzzy logic is proposed for a series hybrid electric vehicle. According to the stat-of-charge of batteries and the power required by the vehicle, the engine output power is real-time changed to realize constant SOC control, and the fuel consumption and emissions are considered as well. The architecture of the vehicle controller is given and a forward simulation model for the vehicle is established. Both off-line and hardware-in-loop simulations are performed. Simulation results show that the fuzzy logic control strategy can maintain the SOC of batteries nearby the exceptive value 0.7,and the engine works at its high efficiency area to get low fuel consumption and emissions.

基于模糊逻辑的SHEV控制策略设计与仿真

摘　要：针对基于模糊逻辑的控制策略，根据蓄电池一辆串联式混合动力电动汽车设计了一种基于模糊逻辑的控制策略，根据蓄电池组荷电状态（SOC）及车辆需求功率的变化实时调整发动机输出功率，以实现恒SOC控制，同时兼顾发动机燃油消耗及排放。给出了模糊控制器的结构，建立了车辆前向仿真模型，进行了离线仿真及硬件在环仿真。仿真结果表明，模糊控制策略能够较好将蓄电池组SOC维持在期望值0.7附近，且发动机可以稳定的工作在其高效率区以获得较低的燃油消耗及排放。

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A learning model based on operant conditioning principles

Abstract. Inspired by Skinner's operant conditioning theory, an operant conditioning learning model is presented to deal with the autonomous learning problem in cognitive robotics. The model is described by nine elements, including the space set, the action set, the bionic learning function and the system entropy etc. A notion "negative ideal rate" is defined to compute the orientation function. The OCLM is applied to solve obstacle avoidance and navigation problems for mobile robots. The experiment results show that the robot based on the model can autonomously learn how to arrive at the goal in a collision-free way through interaction with the environment, and show the effectiveness of the proposed model.

Keywords: learning model,operant conditioning, autonomous learning,bionics,obstacle avoidance

一种基于操作条件反射原理的学习模型

摘　要：针对认知机器人的自主学习问题，提出一种基于操作条件反射原理的学习模型(OCLM)．该模型采用状态空间、操作行为空间、概率分布函数、仿生学习机制、系统熵等进行描述，给出状态的"负理想度"的概念，定义了取向函数的计算方法．运用模型对机器人避障导航问题进行仿真实验，并对参数设置进行了讨论．实验结果表明，基于OCLM模型的机器人能通过与环境的交互获得认知，成功避障到达目的地，具有一定的自学习能力，从而表明了模型的有效性．

关键词：学习模型；操作条件反射；自学习；仿生；避障