基于主成分分析和学习向量量化神经网络的制动工况路面识别与验证㊀

郑国峰[1]，陈文[1,2]，傅涛[2]
1. 重庆交通大学机电与车辆工程学院
2. 凯晟汽车技术（上海）有限公司

【摘要】 开展车辆制动时识别路面类型的研究，提出一种基于主成分分析-学习向量量化神经网络（Principal Component Analysis -Learning Vector Quantization，PCA-LVQ）的制动工况路面识别方法。利用主成分分析对多维度驾驶数据降维处理，提取能表征路面特征的主要成分，采用学习向量量化神经网络对降维处理后的驾驶数据进行训练，并用于路面特征分类，使用制动工况下实车试验数据和硬件在环仿真数据进行验证。结果表明，所提出的 PCA-LVQ 算法能准确识别路面类型特征，路面识别的精度达到 97%，与传统基于 BP 神经网络的路面类型特征识别相比精度提升 7%；同时，在不同车速下，基于 PCA-LVQ 算法也能较准确地识别路面类型特征。

【关键词】 主成分分析，学习向量量化神经网络，制动工况，路面类型特征识别

Road Surface Recognition Under Braking Conditions Based on Principal Component Analysis and Learning Vector Quantization Neural Network

Zheng Guofeng[1], Chen Wen[1,2], Fu Tao[2]
1. *School of Mechatronics and Vehicle Engineering, Chongqing Jiaotong University*
2. *Kesens Automotive Technology (Shanghai) Co., Ltd.*

Abstract: Conducting research on identifying road surface types during vehicle braking, this paper proposes a method for road surface recognition under braking conditions based on the Principal Component Analysis-Learning Vector Quantization (PCA-LVQ) neural network. Principal component analysis was used to reduce the dimensionality of multi-dimensional driving data and extract the primary components that represent the characteristics of road surface. After dimensionality reduction of the driving data, a learning vector quantization neural network was used for road surface feature classification. The approach was validated under braking conditions using real vehicle test data and hardware-in-the-loop simulation data. The results show that the proposed PCA-LVQ algorithm can accurately identify the characteristics of the road surface with the recognition accuracy of 97%, which is 7% higher than that of the traditional BP neural network. Additionally, at different speeds, the PCA-LVQ-based algorithm can also identify the characteristics of the road surface type with greater accuracy. The proposed model provides a more convenient recognition approach and has great potential for application extension.

Key words: principal component analysis, learning vector quantization neural network, braking conditions, pavement type feature recognition

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