

宽度贝叶斯学习模型在抽水蓄能电站滑坡灾害预测的应用研究

Application Study of Broad Learning Bayesian Model for Landslide Disaster Prediction in Pumped-Storage Power Station Projects

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摘要: 在抽水蓄能电站项目中, 滑坡预测对确保工程安全和环境保护至关重要。本研究通过将抽水蓄能电站滑坡数据集应用于宽度贝叶斯模型, 提高宽度学习模型在小规模数据集上的应用效果, 验证宽度贝叶斯模型在抽水蓄能电站工程中的应用前景。本研究结合了宽度学习模型与贝叶斯方法, 提高模型在数据量有限的抽水蓄能电站项目中的滑坡预测能力。研究数据来源于广东省肇庆市抽水蓄能电站的可行性与预可行性研究报告。本研究主要工作是将工程前期勘探的无人机影像数据、数字高程模型、地方降雨量数据预处理, 将宽度学习模型根据贝叶斯原理优化, 应用数据预处理结果以验证改进模型的有效性和适应性。结果显示, 该模型在小规模数据情况下具有更佳的预测性能, 模型的贝叶斯算法为不确定性提供了有效的量化, 进一步增强了其在实际应用中的可靠性。通过本研究, 宽度学习模型的应用范围得以拓展, 为抽水蓄能电站等小规模工程项目提供了一种新的滑坡灾害风险评估和预测工具。这些成果展示了在资源有限的环境下利用先进算法进行有效的灾害预测和治理工程设计的可能性, 对工程安全提供了保障。本研究成果预计将为抽水蓄能电站的滑坡灾害防治和工程安全领域的研究和实践提供新的理论与方法支持。

关键词: 宽度学习模型; 贝叶斯学习; 滑坡预测; 抽水蓄能电站; 小样本数据;

Abstract: In pumped-storage power station projects, accurate landslide prediction is essential for ensuring engineering safety and environmental protection. This study introduces the Broad Bayesian Learning (BBL) Model, designed to enhance the effectiveness of the Broad Learning System (BLS) on smaller datasets typical in such projects. The research data were sourced from feasibility and pre-feasibility study reports of a pumped-storage power station in Zhaoqing, Guangdong Province. This study primarily involved applying the BBL Model to specific engineering data and assessing its effectiveness and adaptability in real-world scenarios. The results indicate that the model delivers superior performance on small-scale datasets, maintaining high predictive accuracy even with limited data availability. Furthermore, the Bayesian algorithm within the model effectively quantifies uncertainties, thereby increasing its reliability for practical applications. This research extends the application scope of the BLS, offering a novel tool for landslide disaster risk assessment and prediction in small-scale engineering projects like pumped-storage power stations. These findings showcase the potential of advanced algorithms for effective disaster prediction and management in engineering design, particularly under resource-limited conditions, thus enhancing engineering safety. This study is expected to provide new theoretical and methodological contributions to the fields of geological disaster prevention and engineering safety.

Keywords: Broad Learning Model; Bayesian Learning; Landslide Prediction; Pumped-Storage Power Station; Small Sample Data;