考慮滲流效應基於改進徑向運動優化邊坡穩定性分析

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摘要

在各種影響因素中，地下水通常被視為導致邊坡滑動的主要因素之一。因此，在邊坡穩定分析中考慮地下水滲流至關重要。本研究將地下水滲流的影響視為水與土壤材料之間的相互作用力（滲透力），用於靜力和力矩平衡分析。基於 Rigorous Janbu 方法，確定用於估算最小安全係數並找到臨界破壞面的方程式。採用了一種新的演算法，即 Improved Radial Movement Optimization（IRMO），用於解決這種複雜、非線性和受限制的優化問題，由於該算法具有高精度和穩定性。對於所提方法的有效性通過文獻中包括均質和非均質坡體的四個不同案例進行了驗證。針對不同優化算法進行了比較研究，以驗證所提出的 IRMO 算法的穩定性和效率。結果表明，所提出的方法在考慮滲流效應的邊坡穩定分析中，相對於幾種現有方法，可以更有效地得到令人滿意和穩定的結果。

關鍵字:邊坡穩定性分析、滲流、Rigorous Janb 方法、改進徑向運動演算法（IRMO）、水位面

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Original Article

Slope stability analysis based on improved radial movement optimization considering seepage effect

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ABSTRACT

Among various effecting factors, groundwater is commonly known as one of the major triggers for slope failures. Thus, it is great significant of considering the contribution from groundwater seepage in slope stability analysis. In this study, the effect from groundwater seepage are considered as the interaction force (infiltration force) between water and soil materials for static and moment equilibrium analysis. Based on Rigorous Janbu method, the implicit equations are determined for estimating the minimum factor of safety and locating the non-circular critical failure surface. A new metaheuristic algorithm, Improved Radial Movement Optimization (IRMO), was adopted to figure out such complex, nonlinear and constrained optimization problem due to its high precision and stability. The effectiveness of the proposed methodology is validated by four different cases including homogeneous and inhomogeneous slopes from the literature. Comparative studies in different optimization algorithms have been carried out to validate the stability and efficiency of proposed IRMO algorithm accordingly. The results indicate that proposed approaches could acquire a more acceptable and stable result with more efficient way in slope stability analysis considering seepage effect over several existing methods.