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ANALYSIS OF SLOPES USING ELITIST DIFFERENTIAL EVOLUTION ALGORITHM

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Abstract: Analysis of man-made and natural slopes has been a challenge for engineers, requiring development of complex computational models to assess the stability hazards and risk levels. These computational models involve combination of analysis tools and integrated optimization solutions, which generally induce intense engineering calculations with upscale time complexity. In order to create reliable engineering solutions within a reasonable amount of time, a robust optimization algorithm is necessary, leading to an efficient stability analysis framework. Within this context, various optimization techniques involving deterministic and metaheuristic approaches were proposed in the past decades. The proposed methods for this purpose often suffer from convergence issues when they involve deterministic paradigms or may be time deficient when stochastic concepts appear. Therefore, development and integration of an effective optimization algorithm is vital. In this study, a modified version of Differential Evolution (DE) algorithm named Elitist Differential Evolution (EDE) is introduced and proposed to solve slope stability analysis problems more effectively. To develop the complete analysis framework, the algorithm is integrated with a non-circular slip surface generation method and limit equilibrium based stability analysis techniques. Then, the performance of EDE is compared with the other optimization algorithms such as conventional Differential Evolution, Particle Swarm Optimization and Grey Wolf Optimization using the benchmark problems reported in the literature. The outcomes indicate that the statistical performance of EDE surpasses other methods, validating the applicability of the algorithm to slope stability analysis problems. Furthermore, convergence rate of EDE has become prominent in the numerical experiments, which further emphasizes the capability of the algorithm.