以強化優勢種為基礎之多目標基因演算法

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摘要

多目標最佳化是一種根據某些限制條件之下同時最佳化兩個以上目標的方法，傳統最佳化方法可能無法有效搜尋到非線性、非凸性解域。多目標基因演算法是其中一種當前最先進的非線性最佳化方法，被廣為熟知的多目標基因演算法有像是 NSGA-II、SPEA-2 等，它們多著重在最佳化過程維持解集合的離散性。然而，也有一些學者如 Dreżewski & Siwik 探討以性選擇理論為基礎之具共演化機制的多目標基因演算法，但並非都具有良好的績效。本研究提出一個改良的多目標基因演算法—強化優勢種基因演算法(strengthen dominant species genetic algorithm, SDSGA)，以雙重排序配適柏拉圖前緣解適應值策略，同時運用綜效優勢評估方法與擁擠程度評估方法使求解更具優勢物種特點。本研究同時使用虛擬問題與投資組合問題進行最佳化實驗，並以正確性、廣度與均勻分布度三項績效指標評量，結果顯示在虛擬問題中，三個以上的目標可以取得良好的績效，但三目標的投資組合問題結果則並未如預期較雙目標投資組合問題好，但最佳化結果與比較基礎 NSGA-II 的表現結果類似，顯示 SDSGA 仍具備近於 NSGA-II 的最佳化能力。本研究確立了共演化機制可以改善需具求解離散性之多目標基因演算法的求解效率性，為後續多目標基因演算法改良求解效率奠定基礎。

關鍵字：多目標最佳化，基因演算法，共演化，優勢種，柏拉圖前緣。

A Novel Multiple Objective Genetic Algorithm Based on Strengthen Dominant Species

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Abstract

Multi-objective optimization is to simultaneously optimize two or more conflict objectives to certain constraints. Because the solution space of multi-objective optimization is often a non-convex or discontinues shape, the conventional evaluation methods are hard to find an efficient frontier efficiently. The multi-objective genetic algorithm (MOGA) is a state-of-the-art nonlinear optimization methodology that applies weight-sum method or Pareto-based ranking schemes. These well-known MOGA methods, such as Non-dominated Sorting Genetic Algorithm-II (NSGA-II) and Strength Pareto Evolutionary Approach 2 (SPEA-2), maintains diversity solution set in the optimization process. However, these MOGA based co-evolution mechanisms, such as MOGAs with sexual selection, are presented to maintain more aggressive solution set. In this study, we introduce an improved MOGA, the Strengthen Dominant Species Genetic Algorithm (SDSGA) that proposed an enhanced selection mechanism with crowding estimation technique to extract more dominated species. The empirical results indicate that SDSGA outperforms in three and more objectives problems.

Keywords: Multi-objective optimization; Genetic algorithm; Co-evolution; Dominant species; Pareto front

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