Introduction

There are many studies on evolutionary algorithms (EAs) solving the real-world optimization problems which are mostly multimodal and complex optimization problems. These problems have not only single global optimum but also many local optima, hence EAs are required to find multiple optima which might be changed as

Swarm Optimization (PSO) [?] and Differential Evolution (DE) [?] are designed to converge toward a single global optimum for the static environment, and these are difficult to find these optima.

To tackle multimodal optimization problems, various niching methods have been proposed. Thomsen proposed the

previous location $x_* - x_i^t$, and frequency f_i which range is $[f_{min}, f_{max}]$ where $f_{min} = 0$ and $f_{max} = 1$. β is uniform random value from 0 to 1. Next, in the local search phase (ii), the new solution x_{loc} is generated around the global best solution as follows:

$$x_{loc} = x_* + \epsilon A^t \,, \tag{4}$$

where ϵ is uniform random value between $[0,\ 1]$. In

niche radius defined above in eq.(**??**) as the threshold. α is the coefficient parameter, basically set to 1. By the *sharing function*, the *niche count* which represents the density of nearby similar individuals *sharing function*, is defined by:

$$m_i = \sum_{j=1}^{N} sh(d_{ij}) \tag{11}$$

Subsequently, *The shared fitness* ϕ_i is given by:

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