DNA sequence design for DNA computation based on binary particle swarm optimization

Abstract

Deoxyribonucleic Acid (DNA) has certain unique properties such as self- assembly and self-complementary in hybridization, which are important in many DNA- based technologies. DNA computing, for example, uses these properties to realize a com- putation in vitro, which consists of several chemical reactions. Other DNA-based tech- nologies such as DNA-based nanotechnology and polymerase chain reaction also depend on hybridization to assemble nanostructure and to amplify DNA templates, respectively. Hybridization of DNA can be controlled by properly designing DNA sequences. In this paper, sequences are designed such that each sequence uniquely hybridizes to its comple- mentary sequence, but not to any other sequences. Objective functions involved are simi- larity, Hmeasure, continuity, and hairpin. Binary particle swarm optimization (BinPSO) is employed to minimize those objectives subjected to two constraints: melting tempera- ture and GCcontent. It is found that BinPSO can provide a set of good DNA sequences, better than basic PSO algorithm in terms of aggregated fitness value.