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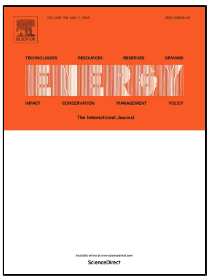

An improvement crossover operation method in genetic algorithm and spatial optimization of heliostat field

Jianxing Wang, Liqiang Duan, Yongping Yang

PII:	S0360-5442(18)30823-5
DOI:	10.1016/j.energy.2018.05.004
Reference:	EGY 12837
To appear in:	*Energy*
Received Date:	29 January 2018
Revised Date:	28 April 2018
Accepted Date:	01 May 2018

Please cite this article as: Jianxing Wang, Liqiang Duan, Yongping Yang, An improvement crossover operation method in genetic algorithm and spatial optimization of heliostat field, *Energy* (2018), doi: 10.1016/j.energy.2018.05.004

An improvement crossover operation method in genetic algorithm and spatial optimization of heliostat field

Jianxing Wang[a], Liqiang Duan[a,*], Yongping Yang[a]

[a] School of Energy, Power and Mechanical Engineering, National Thermal Power Engineering & Technology Research Center, Key Laboratory of Condition Monitoring and Control for Power Plant Equipment of Ministry of Education, North China Electric Power University, Beijing, 102206, China, E-mail: dlq@ncepu.edu.cn

Abstract:

The heliostat field of solar power tower (SPT) system occupies a large proportion of both the total investment and total energy losses of a plant. However, the optimization design of a heliostat field is a challenging work, because there are too many parameters to be optimized. In this paper, a new high-dimensional genetic algorithm toolbox (HDGA) is developed in Visual Studio Community 2015 for the heliostat field design, in which a new crossover strategy is employed for the high-dimensional optimization. The algorithm is verified by both mathematical models and engineering cases, the results show that HDGA is more effective for the high-dimensional problem, and its convergence speed is much faster than that of the genetic algorithm toolbox developed by the University of Sheffield (Sheffield GA). The new algorithm is explained in detail and the optimal field layout is presented. With the new algorithm, a heliostat field referencing to the Gemasolar plant is optimized in this paper. The results show that the optical performance of the heliostat field is improved significantly than that of the un-optimized case, and the optical efficiency of 63.7% is reachable at the design point. At the same time, the annual insolation weighted efficiency is 56.9%.

Keywords:

Solar power tower; Heliostat field design; Genetic algorithm; Crossover operation; High-dimensional optimization.

*Corresponding author, Email address: dlq@ncepu.edu.cn