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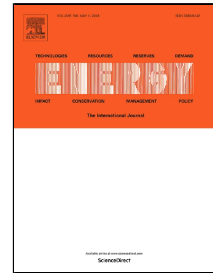
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An improvement crossover operation method in genetic algorithm and spatial optimization of heliostat field

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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.

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