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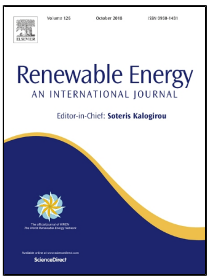


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# A novel optical optimization model for linear Fresnel reflector concentrators

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**Abstract:**

In this paper, a new optical optimization model for linear Fresnel reflector concentrators (LFRCs) was developed, based on the population-based particle swarm optimization (PSO) algorithm and the statistics-based Monte Carlo ray-tracing (MCRT) method, with a validated LFRC MCRT optical module we developed. To significantly reduce the computing time, this LFRC MCRT module was redesigned using a previously proposed MCRT runtime reduction method and a newly proposed nominal annual LFRC optical efficiency together. Optimization results of the model validation were found to agree well with the known data, with average deviations in the optimized nominal annual LFRC optical efficiency being about 1%, while the computing time reduces by almost four orders of magnitude, proving that our novel optical optimization method and model are feasible, reliable and more time-efficient. After validation, optimizations, analyses and comparisons were carried out for LFRCs of different mirrors and geometrical parameters. It is revealed that the LFRC system of flat mirrors studied can also be optimized to obtain a higher annual optical efficiency (over 60%) as compared with those of parabolic or cylindrical mirrors, while the flat mirror is much easier to manufacture than the other two mirrors, with a much lower price due to the use of inexpensive planar mirrors.

**Keywords:**

linear Fresnel reflector; optical optimization; annual efficiency; Monte Carlo ray-tracing; particle swarm optimization