Optical and thermal performance analysis of Linear Fresnel Reflector(LFR) systems

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Recently there has been a worldwide surge of solar energy based power generations. One of the major challenges in solar power generation is intermittent nature of solar energy. Concentrated Solar thermal Power (CSP) technology has an inherited advantage of having cost effective and viable thermal storage. The Linear Fresnel Reflector (LFR) is a one of the CSP technologies, which benefits from a relatively simple and low-cost design. It typically comprises of a single receiver tower and several linear mirror elements. The LFR has a lower optical efficiency in comparison to more conventional solar concentrators such as the parabolic trough or solar power tower. However, in many LFR designs, optical parameters are not properly analysed with the solar field configuration generally being taken from a known solar power plant or prototype. One of the main reasons behind this is the complexity associated with ray tracing, which would be needed to investigate fully the optics of the system, including surface reflections and shadowing. On the other hand, parameters related to receiver heat loss and meteorological conditions affect overall efficiency of LFR. A comprehensive optical and thermal analysis therefore provides opportunities to achieve gains in efficiencies by investigating system performance under different design parameters. In this work, a comprehensive analysis on optical parameters of LFR is carried out using SolTrace, a widely used ray tracing tool, to identify how mirror width, mirror number, mirror curvature and receiver height affects the optical performance. Power output of the LFR system is calculated based on the optical efficiency. A parametric analysis is carried out to identify how mirror field, thermal and meteorological parameters affect the overall performance of LFR.

Biography

M.P.G. Sirimanna is a doctoral researcher in the centre for fluid and complex systems, Coventry University, UK. He is currently working on modelling and optimization of solar thermal power plants. He completed his bachelor's and Master's degrees specialising mechanical engineering from university of Moratuwa, Sri Lanka. His research experience and interests include solar energy, heat transfer and optimization. He has been a university lecturer for six years involving in teaching, supervision and research. He is an associate member of ImechE and Associate Fellow of the Higher Education Academy, UK.

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