EnerTracer: A New Computer Tool for Energy Analysis of Concentrating Systems

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Abstract:

Most high-temperature solar thermal applications use reflective light-concentrating systems to collect and concentrate sunlight. Many different types of concentrators have already been proposed in the literature. Even after a certain type of concentrator is chosen, there are a large number of feasible combinations of design parameters available to the designer within each type. Computational models are required to explore this wide range of alternatives, as the cost of experimental exploration is prohibitive. Whether experimental tests are feasible or not, good simulation models are of interest as they can be used to analyze, interpret and extrapolate experimental results and provide guidance in planning additional experiments.

None of the current computer codes provides a comprehensive solution for the needs of reflective light-concentrating system designers, especially those willing to experiment with new or advanced concepts, such as nonimaging concentrators or multiple-stage concentrating systems.

At CIEMAT's Plataforma Solar de Almería (PSA), a computer code has been developed that overcomes the drawbacks and limitations of present programs. The EnerTracer program, while providing a unifying computational strategy (i.e., a computational framework) for the energy analysis of virtually any light-concentrating system that may be envisioned, is user-friendly, and can be safely and easily adapted, expanded and/or maintained.

EnerTracer is a ray-tracing, Monte Carlo code that runs under Windows 9x/NT. It is written in C++, using the techniques of Object Oriented Programming, and is extremely user-friendly. It incorporates state-of the-art graphics libraries, which allows the user not only to see, in real time, the concentrating system being designed or analysed, but also to "navigate" through the system in 3D.

This paper presents the main design characteristics and functions of the first EnerTracer release, which is now at the validation stage. Some preliminary results of validation are also presented. The flux distribution produced by a new type of heliostat tested at the PSA under precise test conditions is quantitatively compared to the results of EnerTracer's simulation of such testing. Furthermore, the optical behaviour of this heliostat under the anomalous conditions of the partial solar eclipse of August 11, 1999 is qualitatively compared to the EnerTracer simulation of this event.