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Heuristic algorithms to optimize a Solar Power Tower plant

Carmen-Ana Domínguez-Bravo[1], **Emilio Carrizosa**[2], **Enrique Fernández-Cara**[3], **Manuel Quero**[4]

The design of solar power tower systems involves, among others, the heliostat field design (heliostats number, location and size) and the receiver design (number, size, position, aperture tilt, etc.). The variables involved have different influence on the objective function. In our approach, they are considered in two separated sets, those related to the field and those related to the receiver. Since both sets of variables are interconnected, we propose an alternating procedure to optimize the complete solar plant, in which we separately solve the heliostat field location problem when the receiver variables are fixed and vice versa. However, in this talk we are going to mainly focus on the heliostat location problem, as therein lies the main complexity of the problem. In this case, we deal with a highly time consuming black-box objective function with non-convex constraints and an unknown number of variables (which can result in a large number of heliostats in real plants).

Usually, parameterized patterns are applied to solve this location problem. This kind of techniques consists of selecting a geometrical pattern and optimizing the pattern parameters considering an oversized number of variables, see for instance [2, 3]. Pattern-based procedures have been studied since the 90's and most of the already built plants follow a specific pattern, called radial-stagger. However, due to the strong development of this technology during the last years, there exist innovative applications which can not be directly solved by applying these techniques.

We propose a greedy-based heuristic algorithm that sequentially locates the heliostats one by one in the field, see [1]. It is a pattern-free heuristic algorithm, which, in combination with various procedures, turns out to be successful to solve the standard heliostat location problem as well as some of the new variants.

Extensions to multiple receivers fields, fields with different heliostat sizes and location of heliostats in blocks will also be discussed in the talk.

Referencias

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[1]Instituto Universitario de Investigación de Matemáticas, Universidad de Sevilla
Edificio Celestino Mutis- 1ª planta, Avda. Reina Mercedes, s/n, 41012 Sevilla, Spain.
carmenanadb@gmail.es

[2]Dpto. Estadística e Investigación Operativa, Universidad de Sevilla
carrizosa@us.es

[3]Dpto. Ecuaciones Diferenciales y Análisis Numérico, Universidad de Sevilla
cara@us.es

[4]Abengoa Solar, Sevilla
manuel.quero@solar.abengoa.com