Abstract

It is a well-known fact that shadow on solar collectors reduces their output power capability, especially photovoltaic systems due to the mismatch losses. For this reason, the estimation of shadow is an essential part of the design, evaluation and optimization for any study. Different from any other works, the work reported here illustrates an analytical derivation of a general expression for the shading of stationary solar collectors (thermal or photovoltaic) whether arranged aligned or staggered and for the three types of solar fields: horizontal, inclined, and step-like structure solar fields. The shading depends on all design parameters: row spacing, row dimension, collector tilt and azimuth angles, it also depends on the time (day and hour), the location, and the type of the solar field. The effect of all design parameters on the productivity of the field is discussed. Two polynomials representing the minimum spacing ratio to avoid shading as a function of the location latitude and PV panel tilt angle are created for horizontal and step-like structure solar fields. Furthermore, an empirical expression for estimating the solar irradiance incident on the rows of the solar field is presented. A simulation of a study case is reported and discussed. To our knowledge, all equations reported here are new and can be added to the database of programs specialized in PV solar fields to increase their reliability and capability.