Chapter 7
Optical Analysis of Solar Concentrators Using Photogrammetry Process

Safa Skouri
Research and Technology Center of Energy, Tunisia

Salwa Bouadila
Research and Technology Center of Energy, Tunisia

ABSTRACT

As the optical efficiency of solar concentrators has a high impact on its thermal performance. However a qualification method determining the geometrical accuracy of a solar concentrator system is necessary. The purpose of this chapter is to gives an optical analysis of solar concentrator with an imaging process in order to improve the thermal efficiency of the solar concentrator. In this order measurement techniques used to determine geometric errors of the solar concentrating system have been described. Intercept factor, slope error and displacement error have been identified and analyzed. Examples of the intercept factor for concentrator reflector along with optical efficiency has been developed and determined related to the experimental results given by photogrammetry measurement technique.

DOI: 10.4018/978-1-5225-2423-6.ch007

SECTION I: INTRODUCTION

Today the fossil energy situation indicated several weakness aspects due to its limited and pollutant character. Therefore, the investment in the renewable energy sector especially solar energy seems to be one of the potential solutions.

Several under-developed regions around the world receive large amounts of sunlight. Alonso-Montesinos and Batlles (2015) mentioned that Northern Africa and Central Asia receive as much as 7.5 kWh/m^2/day. There is great opportunity to use solar power to provide basic energy needs in these regions. The concentrated solar power (CSP) is considered as the most prominent solar energy technology. There are four types of CSP technologies solar Parabolic trough concentrator, Linear Fresnel mirror, Solar towers (Heliostat field collectors) and Parabolic dish concentrator.

Many solar concentrator applications and projects exist in the world. El Fadar (2015) presents a modeling and optimization investigation of a solar driven adsorption cooling system working with activated carbon–methanol pair they found that there is an optimal range of number of fins varying from 15 to 20 that allows obtaining an optimal performance; the corresponding range of fin spacing is found to be between 4 and 5.2 cm.

Bouvier (2015) presented an experimental campaign that has been conducted on a solar parabolic trough collector feeding a micro-CHP system (micro-cogeneration). The originality of the solar field is the DSG (direct steam generation) using a two axis tracker and a small size (46.5 m2) collector On the studied sunny day, the system produces saturated steam during 8 h with a quality higher than 0.6 for a flow rate of 33 kg/h

(Dascomb, 2009) An economic parabolic dish concentrating system was built at the Sustainable Energy Science and Engineering Center (SESEC) at Florida State University in Tallahassee, Florida. The goal of the project was to provide 6.67 kW of thermal energy. This is the amount of energy required to produce 1 kW of electricity with a conventional micro steam turbine.

Wua SY et al. evaluated the thermal-electric conversion performance of parabolic dish/AMTEC solar thermal power system. The overall conversion efficiency of the system could reach 20.6% with an output power of 18.54 kW. Blanco J et al. described ‘‘Solar detoxification technology in the treatment of persistent non-biodegradable chlorinated industrial water contaminants’’ project,

In order to develop a commercial solar water treatment technology based on compound parabolic collectors (CPC). Kleih (1991) realized a test facility for parabolic dish systems with sterling motor in their focus. Performance ranges from 5 to 25 kWel (depending on concentrator geometry, insolation, and engine). This author described the video-camera measuring system HIMAP used in this work to qualify concentrating modules within the test facility.