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An homemade Solar Tracking system

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Introduction

✓ A solar resource : > 5.5 kWh·m^{-2}.

✓ A need for energy:

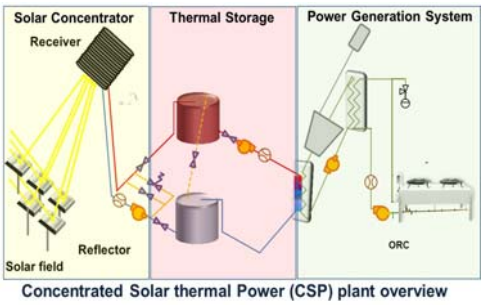
• heat

• electricity

✓ A technology that uses solar resources to meet energy needs

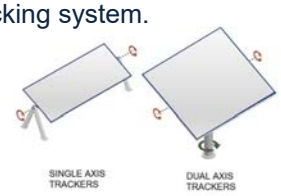
Concentrated Solar thermal Power plants (CSP).

CSP includes the solar concentrator, thermal storage and power generation system.



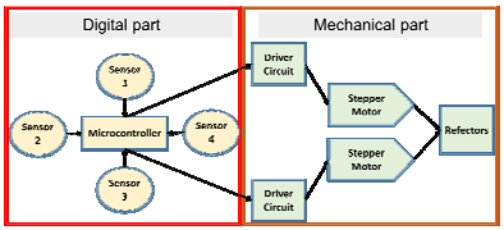
Concentrated Solar thermal Power (CSP) plant overview

we're going to take a look at the CSP's solar field, and more specifically at the sun tracking system.



According to technologies, the reflector require single or dual-axis solar tracking.

A sun-tracking system consists of two parts: a digital and a mechanical.



The digital part calculates both the position of the sun and the inclination to be given to the reflectors, and the mechanical part that moves the reflectors.

There are commercial solar tracking systems but they are expensive and subject to programmed obsolescence.

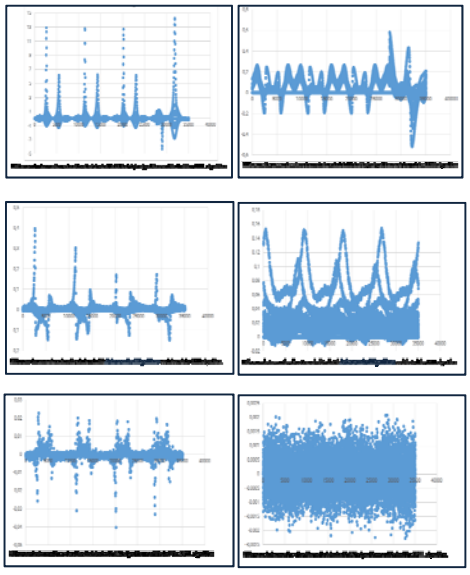
Our purpose is to design an efficient low cost solar tracking system.

Solar tracking: digital part

We used a low cost microcontroller the arduino board. The challenge was to find a solar position algorithms that could be coded on the board.

Three algorithms have been tested: the astronomical Almanac's algorithm, the astronomical Algorithms and the Solar position algorithm (SPA).

Each algorithm was coded and compiled on the Arduino board. Sun Azimuth and elevation angles found after each compilation were then compared to those found , for the same period, on the NREL website (suppose to be the correct values).



In the figures above, we show the difference between the simulated value and that on the NREL website as a function of simulation number.

The SPA is the most accurate of the three algorithms.

Although the SPA is the most accurate; we note that there are periodic peaks in the difference between the calculated value azimuth and the reference one.

This discrepancy can be explained by the lack of in the calculation of the topo-centric hour angle or the topo-centric declination. Regarding the following results, we decided to use the spa for our solar tracking system.

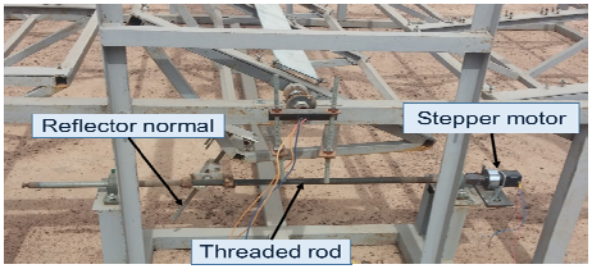
Solar tracking: mechanical part

✓ A threaded spindle is rotated by a stepper motor.

✓ The reflector normal, represented by a cylindrical rod at the rear of the reflector, is connected to the threaded spindle by a screw-nut system.

✓ Rotation of the threaded spindle results in the normal moving along a curvilinear path along the threaded spindle. The moving of the normal causes rotation of the reflector.

✓ Threaded rod, cylindrical rod and screw-nut system are inexpensive and locally available reducing system costs.



Solar tracking: mechanical part