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Evaluation of Solar Position and Angle of Incidence Calculation of the DIN5034 and NREL SOLPOS Algorithms

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Introduction

The solar global irradiance that reaches the earth's surface may not be used as a parameter to control decision making of a photovoltaic system, since it depends on, among other factors, such as: atmospheric conditions and cloud coverage. However, the solar global irradiance that reaches the surface of the photovoltaic cells in the form of direct or diffused irradiance can influence the decision making for control of the photovoltaic system.

The use of solar tracking systems is not essential to the operation of a photovoltaic system. However, It is through solar tracking systems that a gain in energy production through the photovoltaic modules can be achieved [1]–[2].

In this scenario the knowledge and the ability to track the amount of solar global irradiance are essential to plan a strategy for optimized operation before installation, and for this procedure the algorithms play an important role [1].

Solar Position and Angle of Incidence

The positions of the sun can be unambiguously specified for every place on the planet based on two angles: solar elevation (or height) α and solar azimuth γ_s (figure 1).

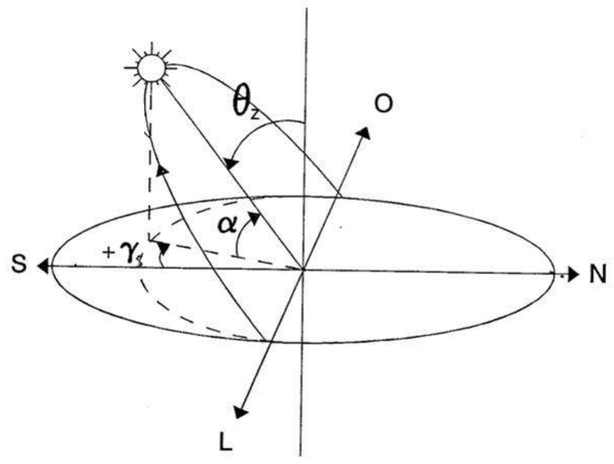

Figure. 1. Angles for the position of the sun.

This paper uses the Solar Basic library, that contains all basic functions and function blocks, as well as the definitions of arrays and structures for all calculation of sun position. The algorithms DIN5034 and NREL SOLPOS defines a solar elevation as the angle between the center of the sun and the horizon as seen from the viewer's position. The solar azimuth describes the angle between the geographic north and the vertical circle through the center of the sun.

Implementation in the PC WORX

PC WORX is a piece of easy-to-operate engineering software. Class 100 and class 1000 modular small-scale controllers as well as the PC WORX SRT software controller with IEC-61131 programming languages ST (structured text) and LD (Ladder) are supported. This was a tool used to implement the function blocks of the algorithms DIN5034 and NREL SOLPOS (figure 2), and the results can be seen in Figures 3 e 4. The figure 5 show the controller AXC 1050.

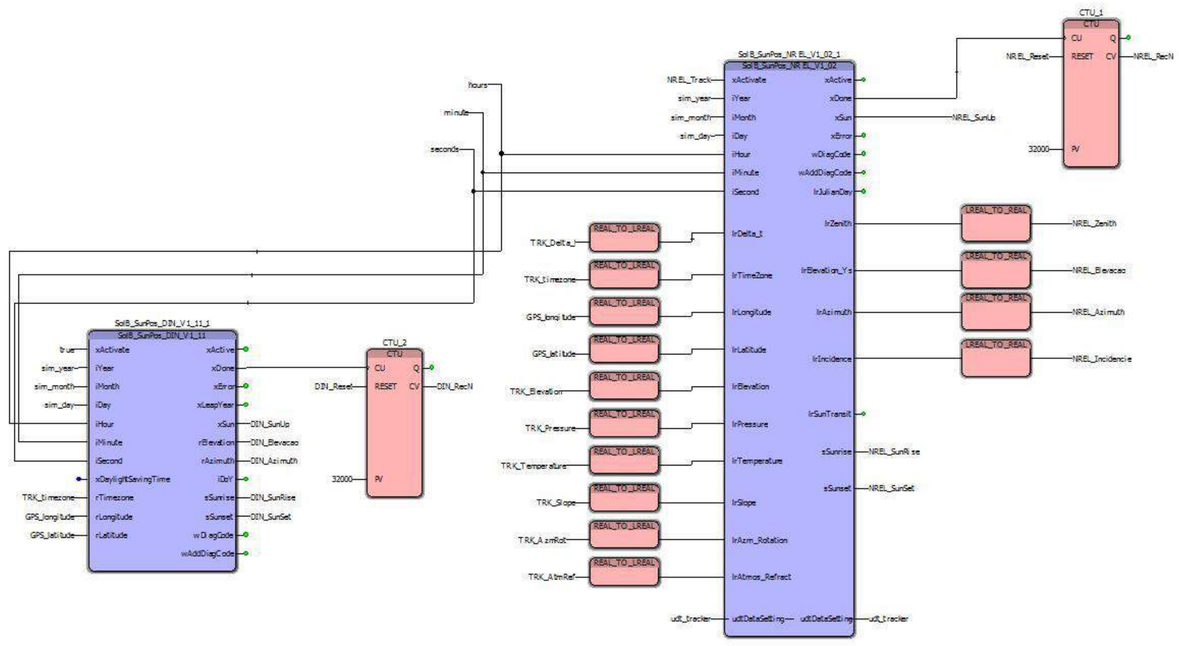

Figure. 2. Algorithm in PCWORX

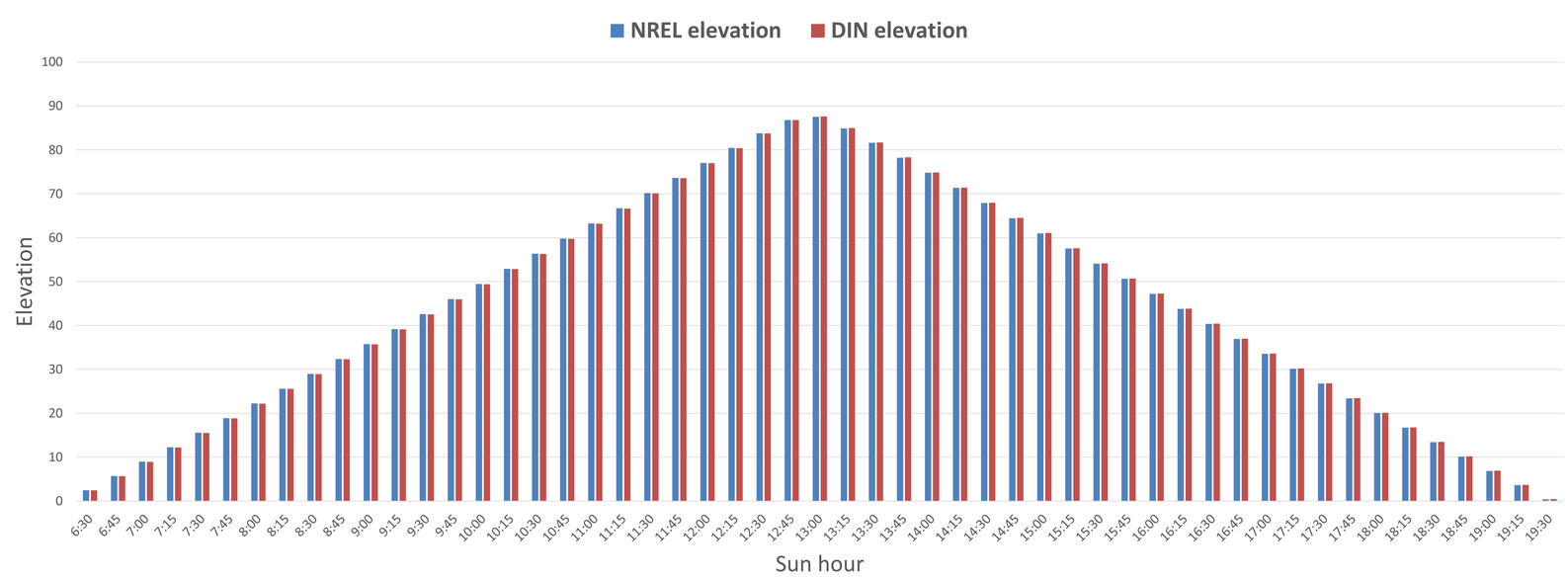

Figure. 3. Compare NREL with DIN, elevation x sun hour.

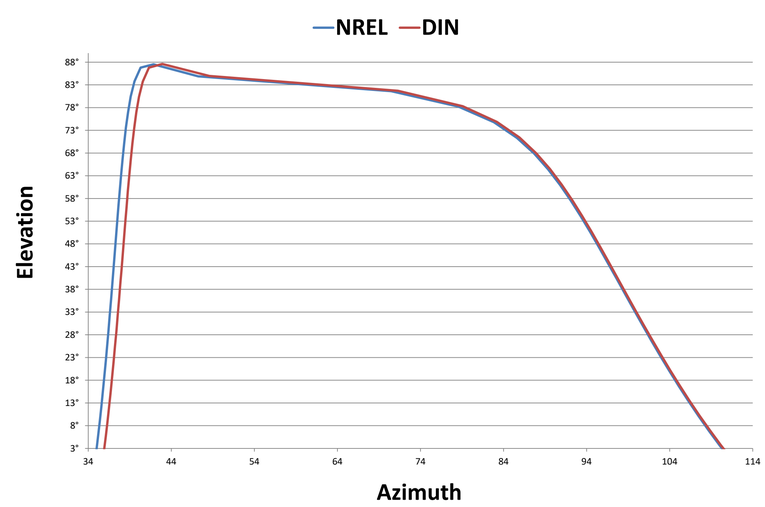

Figure. 4. Compare NREL with DIN, elevation x Azimuth.

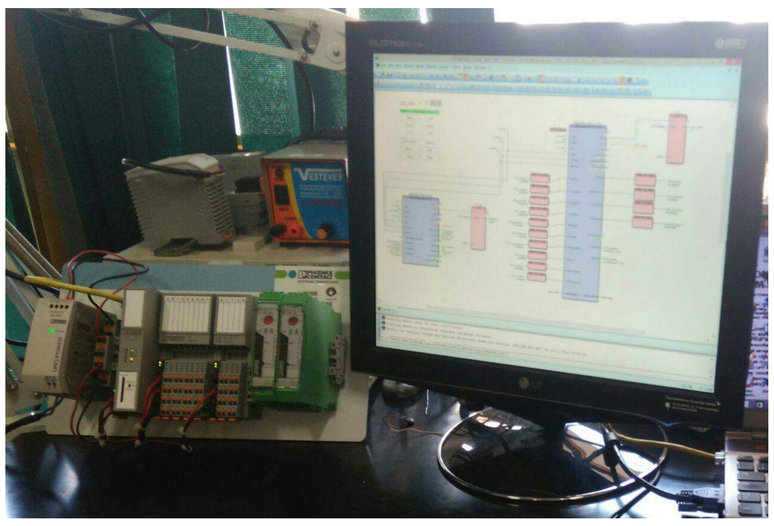

Figure. 5. Controller AXC 1050.

Conclusions

Based on the results, it is possible to observe that the function blocks of DIN 5034 and NREL SOLPOS perform well for the elevation and azimuth tracking. Making it a powerful tool for use in solar tracking system.

References

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[2] H. Loschi, R. Ferrarezi, and N. Rocha, "Solar Tracking System Installed with photovoltaic (PV) Panels to Connection Grid Tie Low Voltage (Sunflower)," Energy and Power, vol. 4, no. 3, pp. 49–53, 2014.

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