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Energy response of a mono-axis tracked solar thermal collector with vacuum tubes

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Abstract. Looking towards a sustainable future, Transilvania University of Brasov develops many projects on diverse renewable energy conversion systems; this paper presents a *solar tracked solar thermal collector (STC) system*, designed for a future implementation on Transilvania University campus. The specific requirement is that the STC system has to be configured to keep a *zero energy response during the summer holydays* (when the energy consumption is null). The proposed solution describes a mono-axial solar tracking system designed to perform an annual step wise tracking program to capture the most of the available solar energy using a solar thermal collector (STC) with vacuum tubes. The tracking program represents an optimised step tracking law developed in dependence with the diurnal movement of the sun.

Numerical simulations are done for one year interval, for Brasov Romania geographic site, to evaluate the daily variations of: the *pseudo-equatorial* solar angles (γ, β); the *pseudo-equatorial* tracking angles (γ*, β*); the incidence angle; the available beam solar radiation (B) and the beam received solar radiation by the STC system (B*).

The energy response of the tracked STC, for Brasov, Romania, is evaluated considering both clear sky and cloudy sky conditions, while neglecting the diffuse radiation effect.

Key words

Pseudo-equatorial tracking programme, beam solar radiation, solar thermal collector (STC) with vacuum tubes, solar thermal collector's efficiency, tracking efficiency

1. Introduction

Sustainable development is the way towards a safe and a quality future life. Accordingly, the EU institutions (e.g. IEE, SEE, EC-Energy) have designated one top priority: *supporting the research and implementation of renewable conversion energy systems.*

Aligning our efforts to the world's direction towards a sustainable development, this paper presents a solar thermal collector (STC) (Fig. 1), easy to manage and maintain, designed to be implemented on Transilvania University campus, Brasov-Romania (45,65° lat. N) [1].

Even though the bi-axial pseudo-equatorial tracking. programme leads to an over 99% tracking efficiency for PV systems [2], it can not be implemented on a STC system because of the pipe structure restrictions [3]. Therefore a STC can be tracked *only according to a mono-axial tracking law*, which can ensure an up to 95% tracking efficiency [2]

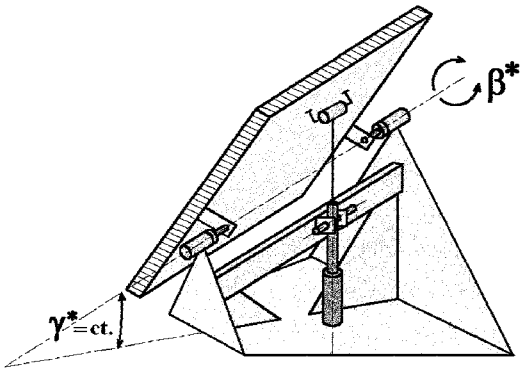

Fig. 1. The mono-axial, pseudo-equatorial STC, tracked according to an optimum annual constant elevation angle γ* = 38° [3] and according to an annual β* hourly step tracking program (Fig. 9)

For the mono-axial pseudo-equatorial model the tracking law (programme) can be set either for *the elevation movement* (γ*) – used on string structures [5] – either on the *diurnal movement* (β*) – used on the stand alone systems.

Because the diurnal movement (β*) has a higher influence in increasing the energetic response than the elevation movement (γ*) [4], the proposed mono-axial pseudo-equatorial stand-alone STC (Fig. 1) functions according to an annual constant γ* = 38° [3] and on an hourly step-wise annual β* tracking programme [3].