



A Simple Method for Predicting the Output of Dual-axis Tracking Systems from Fixed-tilt

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Solar Centre DESERT KNOWLEDGE AUSTRALIA

HISTORICAL DATA

Date Range
 From: 14 Aug 2012
 To: 14 Sep 2012

Download Master (Combined Technologies) Output Variables
 Download Individual Technology Output Variables

Weather Variables

Solar Centre

- Select All
- Global Insolation
- Diffuse Insolation
- Ambient Temperature
- Humidity
- Rain Fall
- Wind Direction
- Wind Speed

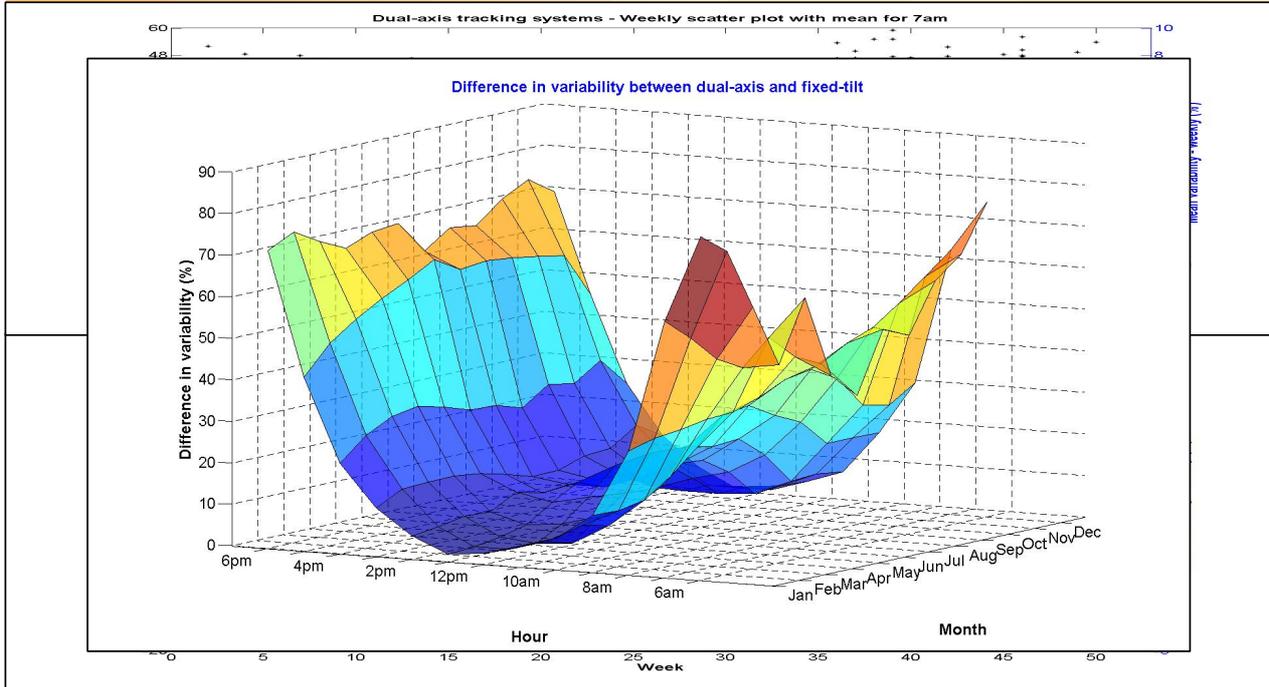
Master (Combined Technologies) Output Variables

Power	Voltage/Current	Power Quality
<input type="checkbox"/> Select All	<input type="checkbox"/> Select All	<input type="checkbox"/> Select All
<input type="checkbox"/> 5-Min-Avg kWa	<input type="checkbox"/> 5-Min-Avg Vin a	<input type="checkbox"/> 5-Min-Avg V1THD
<input type="checkbox"/> 5-Min-Avg kWb	<input type="checkbox"/> 5-Min-Avg Vin b	<input type="checkbox"/> 5-Min-Avg V2THD
<input type="checkbox"/> 5-Min-Avg kWc	<input type="checkbox"/> 5-Min-Avg Vin c	<input type="checkbox"/> 5-Min-Avg V3THD
<input type="checkbox"/> 5-Min-Avg kWtot	<input type="checkbox"/> 5-Min-Avg Vinav	<input type="checkbox"/> 5-Min-Avg I1THD
<input type="checkbox"/> kWh a del-rec	<input type="checkbox"/> 5-Min-Avg Vllav	<input type="checkbox"/> 5-Min-Avg I2THD
<input type="checkbox"/> kWh b del-rec	<input type="checkbox"/> 5-Min-Avg Ia	<input type="checkbox"/> 5-Min-Avg I3THD
<input type="checkbox"/> kWh c del-rec	<input type="checkbox"/> 5-Min-Avg Ib	<input type="checkbox"/> 5-Min-Avg PFa
<input type="checkbox"/> kWh tot del-rec	<input type="checkbox"/> 5-Min-Avg Ic	<input type="checkbox"/> 5-Min-Avg PFb
		<input type="checkbox"/> 5-Min-Avg PFc
		<input type="checkbox"/> 5-Min-Avg Freq

Map Labels:

- 1 LARGE SCALE TRACKERS, DEGERENERGIE
- 2 CROWN PLAZA ALICE SPRINGS
- 24
- 25
- 26
- 27 CIGS
- 28
- 6 SOLAR FOREST 2 AXIS, KYOCERA
- 8 AMORPHOUS SILICON, KANEKA
- 11
- 12 MONOCRYSTALLINE SILICON, BP SOLAR
- 14 POLYCRYSTALLINE SILICON, KYOCERA

Results - Comparative Variability Analysis



Incidence Angle

$$\cos\theta_i = \cos\beta(\sin\delta\sin\phi + \cos\delta\cos\phi\cos\omega) - \cos\delta\sin\omega\sin\beta\sin\sigma + \sin\beta\cos\sigma(\sin\delta\cos\phi - \cos\delta\cos\omega\sin\phi)$$

θ_i = Incidence angle

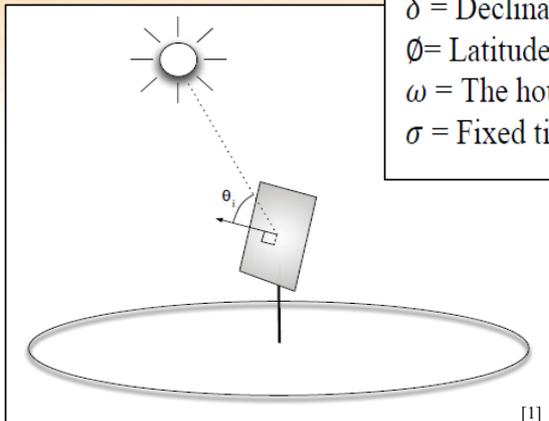
β = Fixed tilt angle of the system to the horizontal

δ = Declination angle

ϕ = Latitude

ω = The hour angle

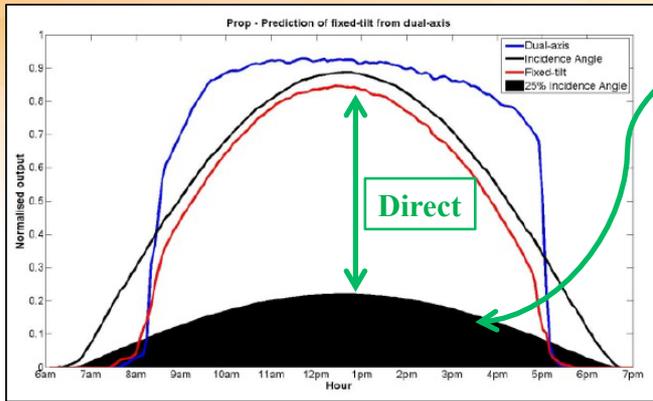
σ = Fixed tilt system azimuth angle



Fixed: 30° to horizontal, due North

Dual-axis: Incident angle = 0

Prediction method – Diffuse Irradiance and Calculation



Fixed Output - Diffuse

÷

Cosine (incidence angle)

+

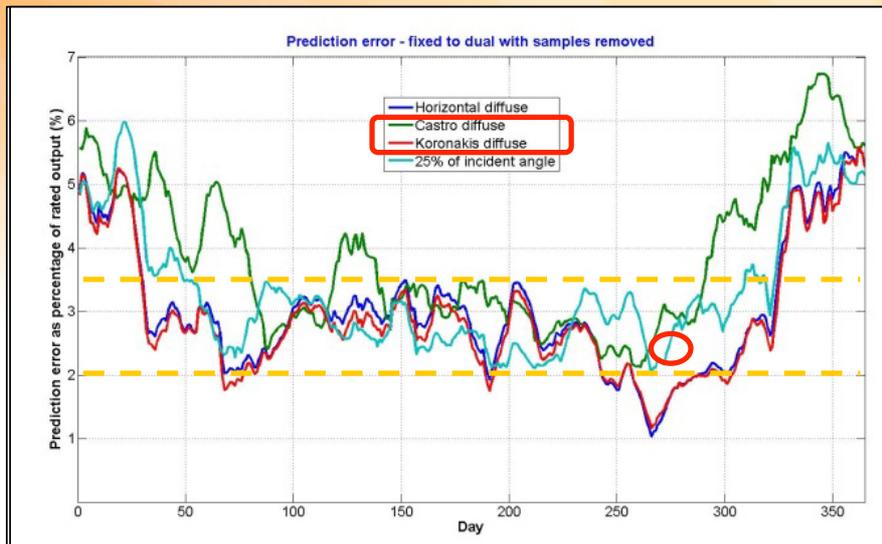
Diffuse Irradiance

Perez

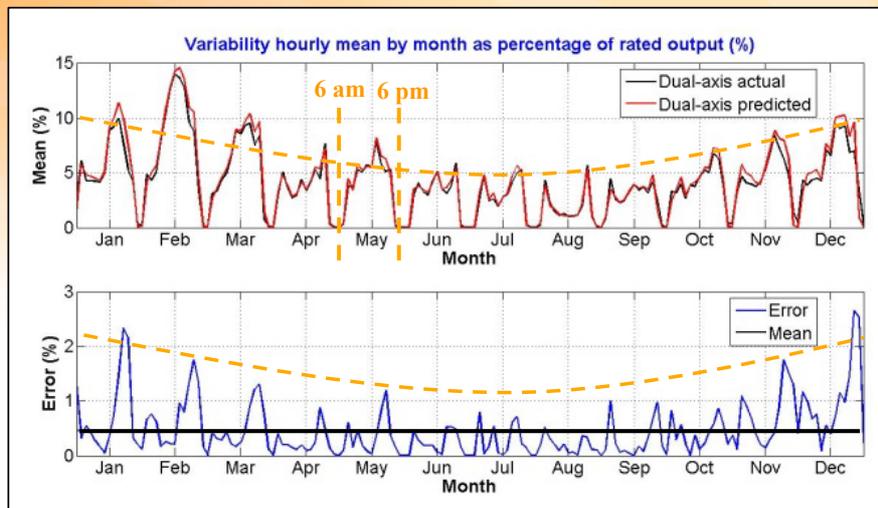
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Dual-axis Output

Prediction Results - Magnitude



Prediction Results - Variability



Benefits/Drawbacks

- ✓ For area's with existing PV output data from fixed systems this method allows for immediate evaluation of the potential magnitude and variability for tracking systems with a reasonable degree of accuracy
- ✓ The alternative is to install pyranometers to accumulate horizontal direct and diffuse irradiance data before then being able to evaluate tracking system behaviour – saves on time and cost
- ✗ Due to its simplicity this method may not meet accuracy requirements. Improving accuracy may require more robust method which uses an estimation of diffuse irradiance on slope



Questions?