Cooling Channel Analysis to Enhance The Efficiency of Photovoltaic Panels

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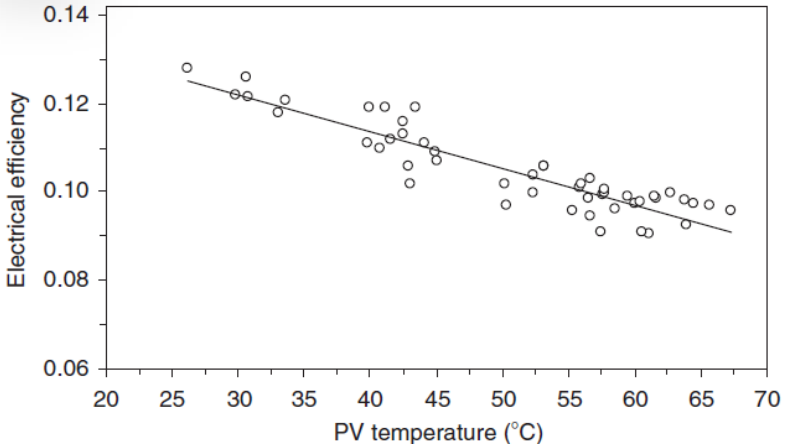
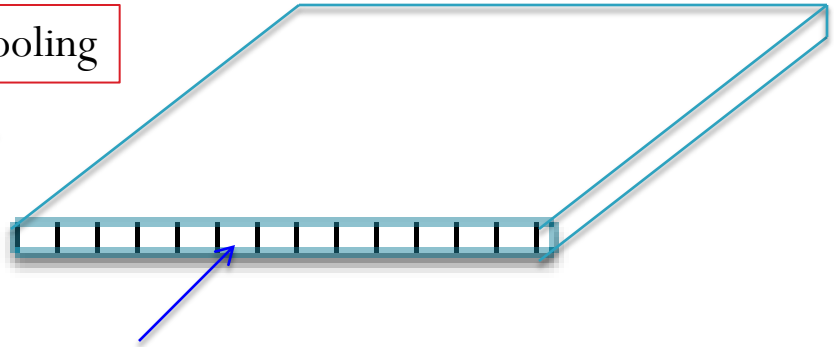
Motivation



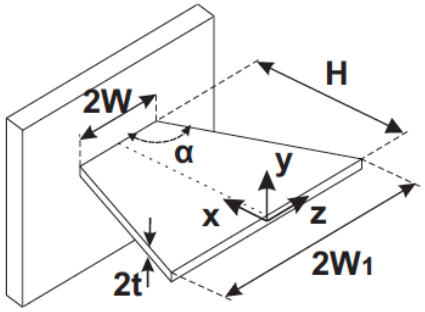
Efficiency Vs. Temperature

J.K. Tonui, Y. Tripanagnostopoulos, Renewable energy, 32 (2007) 623-637

Active Cooling



Passive cooling

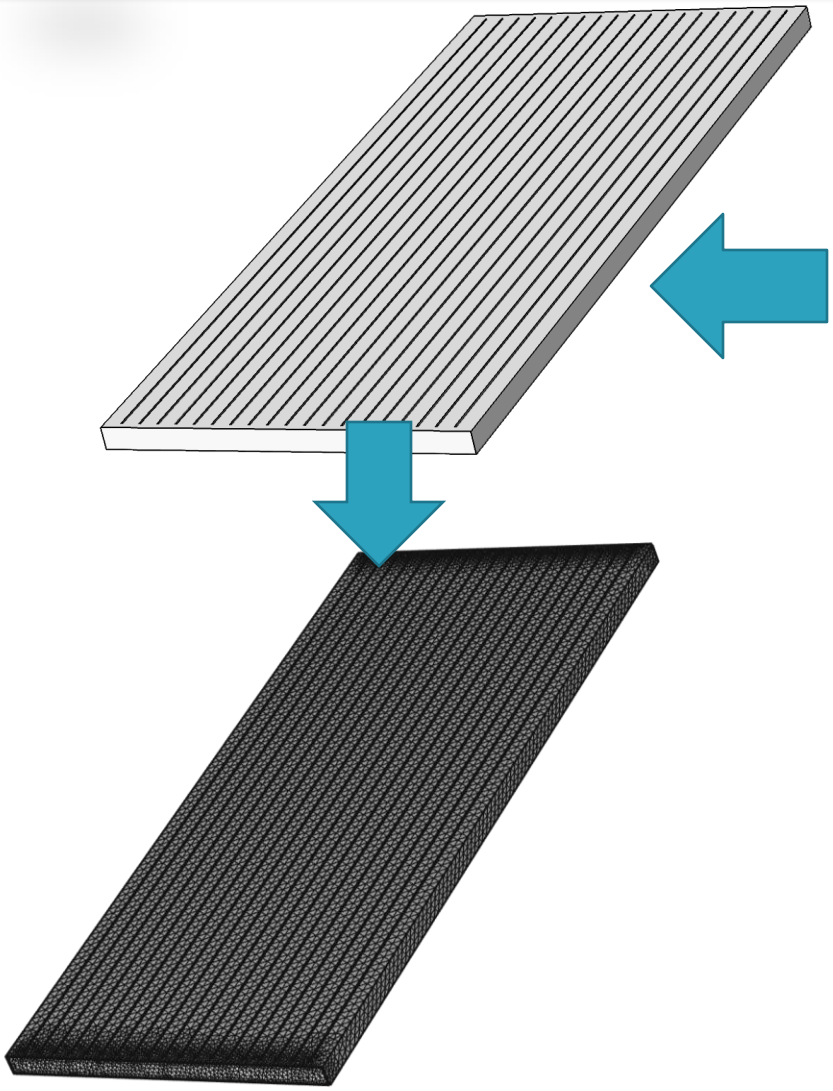


Goal:

- To study different cooling arrangements (geometries)
- Evaluate their impact on PV net power output

See our team poster by
J.D. Osorio, A. Rivera and J.C. Ordonez

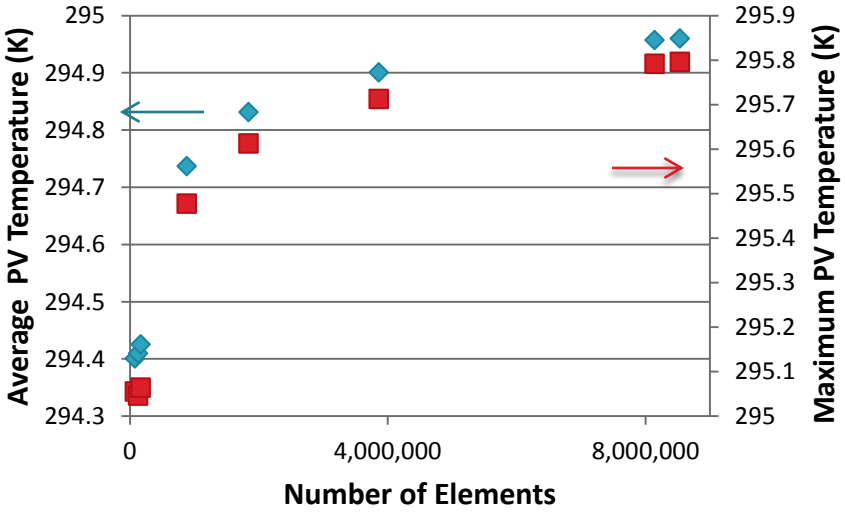
Approach-
Modeling Convective Cooling Channels



Brand	SOLARA
Model	SM 200 S
Origin	Germany
Performance	200 Wh/d
Power (P_{mpp})	50 Wp +/- 10%
System Voltage	12 V
Voltage (V_{mpp})	17.8 V
Open circuit voltage (V_{OC})	21.7 V
Current (I_{mpp})	2.8 A
Short circuit current (I_{OC})	2.98 A
Estimated Albedo Factor (a)	0.30
Area	0.449 m^2

Analysis

Convergence Analysis



Calculation

$$\dot{W}_{total} = \dot{W}_{pv} - \dot{W}_{fan}$$

$$\dot{W}_{pv} = \eta_{pv} I_{solar} A$$

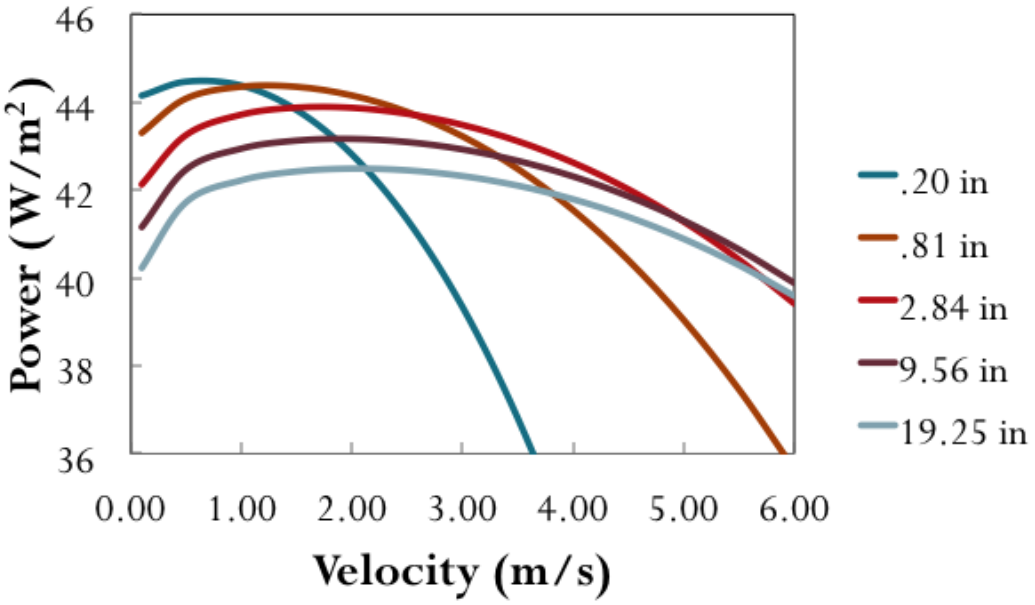
$$\eta_{pv} = 0.147 - 0.0008 T_{panel}$$

$$\dot{W}_{fan} = \frac{\Delta P A_{channels} U}{\eta_{fan}}$$

$$\frac{\Delta P}{\frac{1}{2}\rho U^2} = 13.74(x_+)^{1/2} + \frac{1.25 + 64x_+ - 13.74(x_+)^{1/2}}{1 + 0.00021(x_+)^{-2}}$$

$$x_+ = \frac{x/D}{\mathrm{Re}_D}$$

Results



Future Work:

- Construct physical apparatus
- Apply to PEMFC
- Perform experimental validation

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