Operational research for urban solar development

"PV failure detection based on operational time series"

10/12/2024

Alexandre Mathieu

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Curriculum Plan

Day	Time	Duration	Content
Wednesday 13/11/2024	11h15-12h45 14h15-15h45	1h30 + 1h30	50% Lecture / 50 % Hands-on
Tuesday 26/11/2024	9h45-13h00	1h30 + 1h30	25% Lecture / 75 % Hands-on
Monday 02/12/2024	13h15-16h15	3h	15% Lecture / 85 % Hands-on
Monday 09/12/2024	8h-11h 13h15-16h15	6h	10% Lecture / 90 % Hands-on/Project
Tuesday 10/12/2024	8h-11h	3h	10% Lecture / 90 % Project
Monday 16/12/2024	8-11h	3h	10% Lecture / 90 % Project
Thursday 19/12/2024	9h45-12h45	3h	10% Lecture / 90 % Project
Monday 06/01/2025	13h15-14h45	1h30	100% Project
Monday 13/01/2025	9h45-11h45	1h30	100% Project
Total		**27h**	

Agenda

Review from yesterday

Introduction to the project

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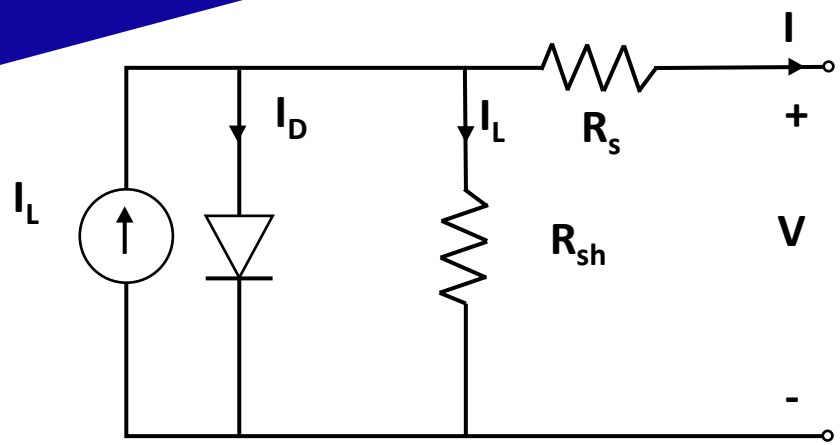
Modeling steps



$$I = I_L - I_0 \cdot \left(exp\left(\frac{V + I \cdot R_S}{a}\right) - 1\right) + \frac{V + I \cdot R_S}{R_{sh}}$$

5. Module and String IV Curve

The 5 parameters $I_{L,STC}, I_{0,STC}, R_{s,STC}, a_{STC}, R_{sh,STC}$ are the 5-parameters at conditions STC ($G_{STC} = 1000 \frac{W}{m^2}$ et $T_{STC} = 25\ °C$).

Then, the parameters at environmental conditions (G: POA irradiance, T_c: Cell temperature) vary according to the following relationships
It expects temperatures in Kelvin !

i. The photocurrent [A] $I_L = \frac{G}{G_{STC}} \cdot (I_{L,STC} + \alpha_{sc} \cdot (T_c - T_{STC}))$

ii. The reverse saturation current [A] $I_0 = I_{0,STC} \cdot \left(\frac{T_c}{T_{STC}}\right)^3 \exp(-\frac{1}{k}(\frac{E_g(T_c)}{T_c} - \frac{E_g(T_{STC})}{T_{STC}}))$

k, Boltzmann constant: 8,617x 10^{-5} [eV/K]

iii. The series resistance [Ω] $R_s = R_{s,STC}$

iv. The product of the diode ideality factor, number of cells and cell thermal voltage [V]: $a(T) = \frac{T_c}{T_{STC}} a_{STC}$

v. The shunt resistance [Ω] $R_{sh} = R_{sh,STC} \cdot \frac{G_{STC}}{G}$ Corrected on the 10/12/2024

vi. The silicon energy band in [eV] $E_g(T_c) = 1{,}121 \cdot \left(1 - 0.000267\ (T_c - T_{STC})\right)$

W. De Soto, S.A. Klein, W.A. Beckman, Improvement and validation of a model for photovoltaic array performance, Solar Energy, Volume 80, Issue 1, 2006

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Review notebook

Notebook recap 09/12/2024

Google collab link: https://colab.research.google.com/drive/1nADZ1DH7rbXfohQS8HPEDMRc8VrOuh-1?usp=sharing

Correction: https://github.com/AlexandreHugoMathieu/pvfault_detection_solar_academy/blob/master/notebooks/iv_curve_modeling.ipynb

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Individual Project

Project Instructions

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Google collab link: https://colab.research.google.com/drive/1-7Z8UrosG_E6Ke3P5_nMpW2-8Ox5SqGv?usp=sharing

Instructions:
https://github.com/AlexandreHugoMathieu/pvfault_detection_solar_academy/blob/master/slides/2024/project_instructions.pdf

Heliocity
ANALYTICS FOR SOLAR BUILDINGS

That's it