

Operational research for urban solar development

“PV failure detection based on operational time series”

10/12/2024

Alexandre Mathieu



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

Agenda

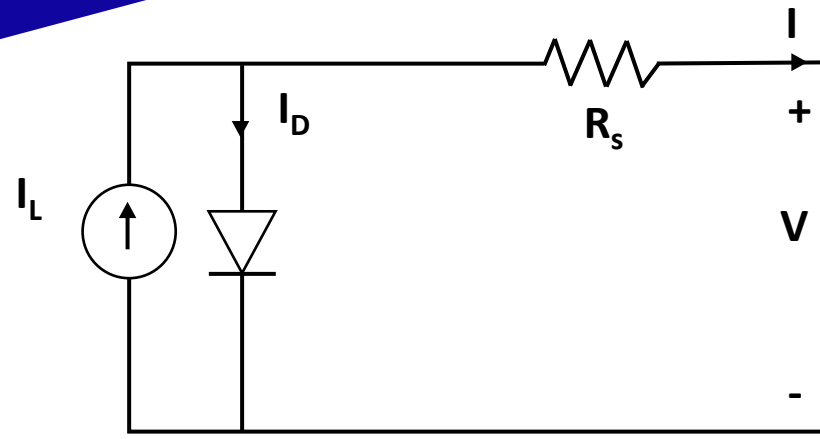


Review from yesterday

Introduction to the project

Modeling steps

5. Module and String IV Curve



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

Les 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 $T_{STC} = 25^\circ C$).

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] $I_0 = I_{0,STC} \cdot \left(\frac{T_c}{T_{STC}}\right)^3 \exp\left(-\frac{1}{k} \left(\frac{E_g(T_c)}{T_c} - \frac{E_g(T_{STC})}{T_{STC}}\right)\right)$
- 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] $E_g(T_c) = 1,121 \cdot (1 - 0.000267 (T_c - T_{STC}))$

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

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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Review notebook yesterday

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Project Instructions

Individual Project

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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

That's it

