



LOCIE

UNIVERSITÉ
SAVOIE
MONT BLANCines
INSTITUT NATIONAL
DE L'ÉNERGIE SOLAIRE

Internship offer - M2

Title	Analysis and characterization of solar energy variability in urban environments	
Student level	M2 research	
Starting date	February/March 2022	
Duration	5 to 6 months	
City, Country	Le Bourget du Lac, FRANCE	
Laboratory	LOCIE - Laboratoire Optimisation de la Conception et Ingénierie de l'Environnement https://www.univ-smb.fr/locie/	
Internship description	<p>The solar resource is by nature variable: during a day the production of a solar energy system can go from its maximum to a value close to zero in just a few seconds. This variability has two causes, the first is the result of the apparent movement of the sun relative to the earth, the second depends on the movement of clouds and more generally on weather conditions. In the case of a high penetration rate of solar energy and particularly of photovoltaic (PV) production, this variability can lead to sudden variations in electrical production (power calls) which represent real challenges for network managers. Thus, a massive deployment of solar energy is impossible if its intrinsic spatio-temporal variations are not controlled.</p> <p>Spatio-temporal distribution and variability at the scale of a large territory, such as a region or a country, has been the subject of many studies, and probability laws and prediction models have been developed (Perez et al. 2016). However, this is not the case at the urban and intra-urban scale due to, among other things, the heterogeneity of orientations and inclinations of the producing surfaces (especially facades), the complexity of shading between buildings, the influence of outdoor conditions or urban climate (Freitas et al., 2019). Also, a good knowledge of this resource is necessary since on it depends the reliability, robustness and performance of integration, management and operation strategies.</p> <p>The objective of this work is to better understand this variability through its spatial characterization (pattern recognition, shaded areas/neighborhoods, influence of urban morphology) and temporal (spectral analysis, characteristic time scales, etc...). In this perspective, the candidate will implement methods of information processing by machine learning or statistical approaches (Principal Component Analysis, Fourier analysis, neural networks...) in order to analyze sunshine data of different neighborhoods. Based on this characterization, this project aims to identify strategies for the management and integration of solar energy in urban areas.</p>	
Candidate	<p>This study will mobilize general knowledge on physics, especially radiation. Knowledge of data analysis methods will also be appreciated (eigenvalue decomposition, Fourier analysis, etc.).</p> <p>The candidate should have a strong taste for research, as the candidate could then be supported by the laboratory for a request for funding for a thesis. In this perspective, the candidate should have an excellent academic record (very good ranking within his or her class).</p>	
Traineeship grant	Legal internship salary (~575 €/month)	
Supervisors	Martin Thebault CR – CNRS LinkedIn / ResearchGate (LOCIE – Le Bourget du Lac)	Julien Ramousse MCF HDR – USMB (LOCIE – Le Bourget du Lac)
Deadline	Send CV + Cover Letter to martin.thebault@univ-smb.fr Before 31 December 2021	
References	<p>Perez, Richard, et al.(2021) Spatial and temporal variability of solar energy. <i>Now Publishers Incorporated</i></p> <p>Freitas, S., & Brito, M. C. (2019). Solar façades for future cities. <i>Renewable energy focus</i>, 31, 73-79.</p>	