ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2015

Axe Sophi@Stic :
SystèmesRéseaux|Environnement|

Titre du sujet :
Stochastic models for solar energy and their applications

Mention de thèse :
Informatique

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Description du sujet :

Renewable energy is energy that is produced by natural resources such as wind, sunlight, waves, etc. The present work focuses mainly on solar energy and aims at modeling the current that comes out of photovoltaic (PV) panels. The solar irradiance exhibits a night-day behavior but is also affected by weather conditions. Such conditions may induce burstiness in the energy produced. Models for the clear sky solar irradiance at zenith have been developed (see for instance [1]), but it remains a challenge to account for the actual irradiance received by PV panels at any time of the day. Measurements of the solar irradiance (direct or diffuse) are often available, such as those provided by NREL [2]. Recent studies have proposed analytical models for shaping the solar power; see [3] and [4]. During this thesis, stochastic models should be developed. Both discretized and fluid models will be considered. All developed models will be tested against the real measurements and their pros and cons thoroughly studied.

In a second phase of the thesis, these models of renewable supply will be used to analyze energy harvesting communication networks. These systems have the capability of obtaining part of their energy from renewable resources, and need to be equipped with sophisticated energy management algorithms. Applications include base stations in cellular networks, sensor networks, communicating objects in general. To this end, it will be necessary to couple appropriate energy harvesting, storage and consumption models with models of data traffic typical of the application. For instance: Internet traffic and signalling in case of base stations in cellular networks or measurement and signalling traffic in case of sensor nodes, etc.

References:

[1] R. E. Bird and R. Hulstrom. A Simplified Clear Sky Model for Direct and Diffuse Insolation on Horizontal Surfaces. Solar Energy Research Institute, Technical report SERI/TR-642-761, February 1981.
[2] National Renewable Energy Laboratory (NREL). http://www.nrel.gov/.
[3] Marco Miozzo, Davide Zordan, Paolo Dini and Michele Rossi. SolarStat: Modeling Photovoltaic Sources through Stochastic Markov Processes. In Proc. of IEEE EnergyCon 2014.
[4] Y. Ghiassi-Farrokhfal, S. Keshav, C. Rosenberg, and F. Ciucu. Solar Power Shaping: An Analytical Approach. in IEEE Trans. on Sustainable Energy, Vol. 6, Issue 1, January 2015.

English version: