PhD Proposal 2017

School: Centrale Lille	
Laboratory: L2EP	**Web site: http://l2ep.univ-lille1.fr/**
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Title: Modeling, supervision and optimization of a multi renewable sources system
Scientific field: Electrical Engineering and Computer sciences
Key words: renewable energy, modeling, control, optimization

Details for the subject:

1. PhD Objectives

Renewable energies contribute to the CO2 reduction and societal development of rural communities where the electrification rate is low or nonexistent. The PhD objective is to study, model, supervise and optimize a multi-source system for supplying renewable energy, for the following priority uses:

- Autonomous telecommunications relay in isolated locations
- water pumping system
- water treatment system (salinity or quality)

The main objectives are to optimize the production of electric power from renewable resources. In a first time, it is necessary to select a non-electrified rural community (for example in China). Then electrical energy needs have to be assessed and production from renewable sources have to be adapted in the final hybrid system. Knowledge of energy potential and consumption profiles of the selected community is also an important step.

2. Problematics and issues

From a scientific point of view, it is necessary to remove the barriers associated with thea combination of renewable energy sources whose characteristics are very different (photovoltaic, wind, solar thermal, biomass-based diesel,).
There is also the problem of storage because of energy production and end-use consumption. Infact, storage elements must be properly sized and optimized to avoid excessive economic and ecological costs. Aspects of maintenance and service will also be considered. In addition, innovative strategies for supervision and energy management must be developed.
The PhD project involves the choice of components and the study of their optimal integration.
The last point to study is the use and operation of such a system to ensure a minimum lifespan of 20 years. Robustness of final system components must be evaluated.
3. Proposed Methodology
In this PhD project, we are interested only in isolated sites not connected to the electricity network. Multisource systems ensure power quality that is significantly improved compared to single systems. However, such systems are inefficient. It is then necessary to improve efficiency at the component level and for global system.
The project will study the following themes :

- Estimation of renewable energies resources. Production data are not always known for one given site and often their frequency is too vague to properly estimate the potential. It is then necessary to develop one methodology to know with good accuracy one site renewable energy potential.
- Study of power conversion architectures. It is necessary to define the architecture associated with energy generators as well as electric energy storage elements. This study will focus on optimizing the design of multi-source system components as well as the control of power converters. The design must be adapted to the consumption profile according to applications to meet (telecommunications, pumping, treating water,).
- Study of generators and storage sources aging. There are certain parameters that can accelerate the aging of generators such as photovoltaic panels (dust, heat,). The project aims to study the operating conditions and provide solutions to increase the lifetime of these generators. Storage elements (battery, super capacitor,) lifespan assessment is also crucial. The objective of this study is to prevent storage elements aging to ensure better maintenance.
- The last point that the project will study is the economic, energetic and ecologic assessment of multi-source system. In this part, it is necessary to develop one algorithm or one tool to optimize these several criteria to design the multi-source system.

3. Expected Results

The expected results are:

- Development of a methodology to facilitate the design and integration of a multi-source system.
- Implementation of a prototype combining multiple energy sources and the associated storage.

4. References

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