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# Optimization of a Multi-Source System with Renewable Energy Based on Ontology

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**Abstract**

This article presents a contribution to the optimization of a multi sources system with renewable energy system.

Following the limits of conventional design methods in the reasoning aspect, also renewable energy hybrid systems are distributed nature, open and includes huge detail information needs a formal representation and a shared conceptualization by dynamic contribution to the change in weather conditions of installation site of hybrid system. We propose an approach based on hybridization between sizing techniques and ontology domain. The introduction of ontology in such systems allows the shared knowledge representation of a common area of a unit. Moreover, these will conceptualization of knowledge that can be updated without changing the system goals.

The aim of the work presented in this paper is essentially the conceptualization of the ontology after the presentation of the proposed approach. "Protege2000" is used for editing the ontology. The purpose of this work is a knowledge base which contains a representation of all concepts and informational system details.


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*Keywords:* Optimization, Multi sources to renewable energy system, Reasoning system, Distributed system, Formal and common representation, Conditions weather, Sizing techniques, Domain ontology, Protege2000

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## 1. Introduction

The renewable energies appear in our days and for a long-term as the adequate solution which covers this energy need by decreasing the major inconvenience emitted by the fossil fuels.

The work presented in this article is a part of the optimization and the engineering of the knowledge for the renewable energy multi-Sources systems.

The ontology is the most used approach for the formal representation and the knowledge capitalization in the modeling field [1, 2].

The deployment of ontology in modeling allows the intelligent integration of information and the knowledge management. The ontology allows supplying a shared and common knowledge on a given domain. They define primitive and essential for their representation, as well as their semantics in a particular context [3, 4]. Besides, the reuse and the division of the knowledge, allow facilitating the communication between the actors of the various bodies, in particular the realization of the interoperability between the various systems. They allow not only the creation of system with knowledge but also to argue about this knowledge and to contribute in providing its current news [5, 6].

This article is organized as follows: the section 2 presents the domain and the type of systems concerned by our study. It contains, in particular, an overview on the essential elements of these systems. The section 3 is dedicated to the presentation of the approach proposed for our conception. The section 4 illustrates the techniques of sizing specifically. The section 5 is reserved for the construction of ontology of the domain. We end with a conclusion and perspectives.

**Nomenclature**

| | |
|---|---|
| $P_{pv}$ | Photovoltaic power generation (W) |
| $G_t$ | Global solar irradiation (W/m$^2$) |
| $A_{pvg}$ | Surface of photovoltaic generator (m$^2$) |
| $\eta_{pvg}$ | Efficiency of conversion |
| $\eta_r$ | Photovoltaic module reference efficiency |
| $\beta$ | Temperature coefficient |
| $T_c$ | Solar cell temperature (° C) |
| $T_{c\ ref}$ | Reference solar cell temperature (° C) |
| $T_a$ | Ambient temperature (° C) |
| NOCT | Nominal operating cell temperature |
| V(Z) | Wind speed in anemometer level(m/s) |
| $V(Z_a)$ | Wind speed in the desired level (m/s) |
| $\alpha$ | Coefficient characterized wind cutting |
| $Z_a$ , Z | Height wind turbine (m) |
| $Cap_{bat}$ | Battery bank capacity(Ah) |
| $E_{ld}$ | Load demand (W) |
| Nja | Number of autonomy days |
| $\eta_{dis}$ | Battery discharging efficiency |
| U | Installation voltage |
| V | Wind speed (m/s) |
| $\eta_{inv}$ | Inverter efficiency |
| $E_{pv}$ | Photovoltaic generator power production |
| $C_i$ | Initial cost |
| $C_{i\_wt}$ | Initial cost of the wind system |
| $C_{i\_pv}$ | Initial cost of the Photovoltaic system |
| $C_{i\_bat}$ | Initial cost of the storage system |
| $C_{i\_inv}$ | Initial cost of the inverter |
| $N_{bat}$ | Battery number |
| $S_{inv}$ | Apparent power of the inverters |
| $C_m$ | Maintenance cost |
| $m_w$ | Maintenance cost of the wind system |
| $m_{pv}$ | Maintenance cost of the Photovoltaic system |
| $m_{bat}$ | Maintenance cost of the storage system |
| $m_{inv}$ | Maintenance cost of the inverter system |
| $dv_{sys}$ | Life time of the system (years) |
| $dv_{wt}$ | Life time of the Wind generator system (years) |
| $dv_{pv}$ | Life time of the Photovoltaic generator system (years) |
| $dv_{bat}$ | Life time of the storage system (years) |
| $dv_{inv}$ | Life time of the inverter system (years) |
| $C_g$ | System global cost |