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STABILITY STUDY FOR OPTIMAL ENERGY MANAGEMENT IN MULTISOURCES BUILDING

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Abstract. Multi-sources building is a complex system composed of different types of electrical sources, solar panels, batteries...etc. To optimally anticipate the energy management a lot of input data should be taken in account, like weather forecast, energy prices, load variation…etc. Furthermore anticipation may have different equivalent strategies as consequence of problem formulation. In this paper a stability study applying numeric analyses on the optimization problem of energy management is studied.

Keywords: Energy management, Stability analyses, multi-sources buildings.

INTRODUCTION

The energy consumption in buildings presents 29% of the total energy consumption in the world and 46% in the industrial countries like France. A lot of previous works formulate the optimization problem of energy management that can then be solved with different algorithms, tools and methods [1] [2] [3]. In these studies the optimization problem is formulated as a linear problem (LP). Sometimes, the results of such energy management optimization problems had equivalent solutions (W effect) [2], this means that there is at least two strategies (different solutions to the same optimization problem) to dispatch the sources without affecting the value of objective function. Authors in [6] present stability analysis of production systems in uncertainty data context; however in this work uncertainty is not studied. The stability radius of an optimal solution is defined in [7], in analogy with this definition, this paper presents a numeric approach to find out the radius of equivalence in multi-sources buildings.

PAPER ATTRIBUTES

Equivalence radius calculation approach

An algorithm is proposed to explore the neighborhood of an optimal solution searching for other solutions that might be equivalent (same value of the objective function). The first advantage of this approach is the possibility to find the equivalence radius of an optimal solution; it means the maximum distance which may exist between two equivalent solutions, the second is to find a set of equivalent solutions which is a very important information to give to the dispatcher, as it helps him to choose the best practical usage of sources. Indeed equivalent solutions in optimisation meaning may have rather different properties in energy management one. This is the reason why such a study is relevant in this field of application.

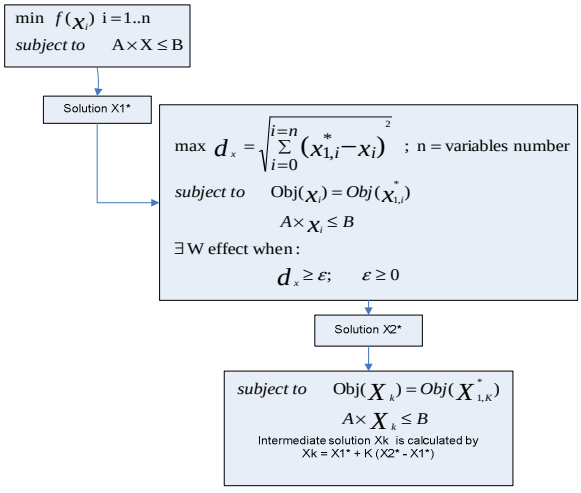

Figure 1 Numeric approach to find out the stability radius for linear optimization problem

Implementation and results

The Algorithm in Fig 1 has been implemented for a problem of minimizing the electricity bill for a multi-sources system over 24 hour. The Numeric approach is applied via an optimization environment developed in G2Elab called CADES [4], by varying k between 0 and 1 equivalence curves were found, the maximum radius is for k=1 while k=0 give the initial solution. Results in Fig 2 show an example of anticipation plan for grid and solar panels found by the energy management algorithm (x1 and x3), while (dx1 and dx3) are the energy equivalence radius for each of these variables without affecting the electricity bill at the end of the day (considered as objective function of the problem). Calculating the radius ration as a relative value ($dx_{(t)}/x_{(t)}$) shown that it is about 0 to 32% for grid energy and 0 to 75% for panels surplus (when k =1.0) this means that the radius is not negligible. In fact, making use of this radius is the issue of further works.

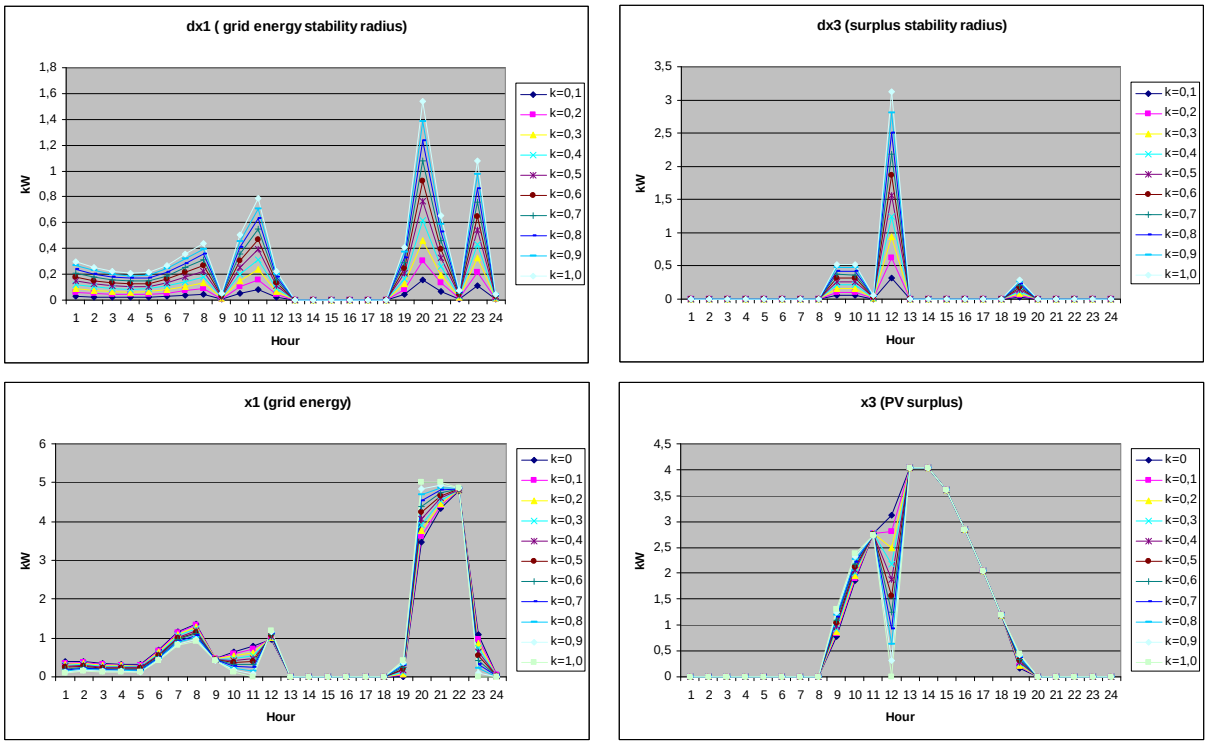

Figure 2 Equivalent curves found by the numeric approach

CONCLUSIONS

In this work a equivalence radius of optimal solution in multi-sources system is investigated, a numeric approach is proposed and implemented; results show that: firstly such optimization problem may have equivalent solutions, secondly with this algorithm most of them could be found, the perspective is to make use of these equivalent solutions to help manager in handling uncertainty in input data by choosing solution that fit to data change. More studies are needed to generalize and apply this approach for non linear optimization problem.

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