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Modeling and Optimization of a Micro-Grid: Huatacondo, Isolated Village in Northern Chile

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With a low population density and many natural resources, Chile's electricity supply shortage is a paradox. The Atacama Desert, Andes Mountains, long coastline and strong agriculture provide the country with abundant distributed renewable energy resources that could, according to recent estimations, largely surpass the fast-growing electricity demand. In addition, because of the geographic conditions of extreme points in Chile, there are still several small settlements deep into the mountains that are isolated from the interconnected power system. In this context, renewable-based technologies offer a solution for gathering the distributed energy resources.

In these communities, the energy supply is difficult to predict because it is not always available, is limited according to some schedules and is highly dependent on the consumption behavior of each community member. The proposed method is used before the implementation of the micro-grid in the design stage, and it includes a household classifier based on a Self Organizing Map (SOM) that provides load patterns by the use of the socio-economic characteristics of the community obtained in a survey.

For the micro-grid operation, an energy management system (EMS) based on a rolling horizon strategy is proposed. The EMS provides online set points for each generation unit and signals for consumers based on a demand-side management mechanism. The proposed EMS is implemented for a micro-grid composed ofphotovoltaic panels, two wind turbines, a diesel generator and an energy storage system. A coherent forecast information scheme and an economic comparison framework between the RH and the standard unit commitment (UC) are proposed.

Both proposals are tested in a real-life micro-grid located in Huatacondo, in northern Chile. The results show that the estimated daily load profile of the community can be very well approximated with the SOM classifier. The results based on different operation conditions show the economic sense of the EMS proposal.

Biography

Doris Sáez received the M.Sc. and Ph.D. degrees in electrical engineering from the Pontificia Universidad Católica de Chile, Santiago, Chile, in 1995 and 2000, respectively. She is currently a Visiting Professor with Electrical and Computer Engineering, University of Waterloo. She is an Associate Professor with the Department of Electrical Engineering, Universidad de Chile, Santiago. Her current research interests include fuzzy systems control design, fuzzy identification, predictive control, the control of power generation plants, and the control of transport systems. Dr. Sáez is the Chair of the Chilean chapter of the IEEE Computational Intelligence Society. She is an Associate Editor for the IEEE TRANSACTIONS ON FUZZY SYSTEMS.