Sizing and Optimization of Wind, PV Array and Battery hybrid system by incorporating resource uncertainty

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The renewable sources are prominent options to fulfil the energy demand, but unreliable due to the stochastic nature of their occurrence. Hybrid renewable energy system (HRES) combines two or more renewable energy sources like wind turbine and solar system. This is seems to be encouraging solutions to provide reliable power supply with improved system efficiency and reduced storage requirements for standalone applications. Optimum sizing of the solar-wind-battery hybrid system is difficult for technological develop and economic feasibility. The graphical representation of the technique termed as "design space" has been utilized in this report. It is multidimensional parametric space within which feasible solutions of the system is obtained. For a standalone solar-wind-battery hybrid system, main variables are rating of resources and photovoltaic panel area, battery bank capacity. Feasible combinations of these variables determined through a time step simulation procedure is represented on a two dimensional plot of PV rating vs battery bank capacity with given wind turbine rating as a input parameter. The inputs to the simulation include the load and resources data, characteristics of wind turbine and battery. The wind turbine is selected based on modelling of wind turbine.

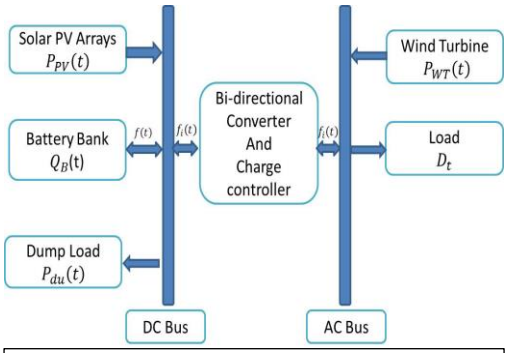

Fig. Schematic of renewable energy based isolated power system

Such a solution allows freedom to independently vary the PV area as well as wind turbine rating. The design space approach is first presented considering solar radiation, wind speed and load as deterministic variables. This methodology can be used various applications. The design space representation gives us inter-connection of the primary variables. Through the design space of solar-wind-battery hybrid system, the maximum and minimum battery bank capacity for given wind rating and PV rating with in feasible system may be designed is identified. Such a method gives us practical vision to select best and suitable solution for given site. A chance constraint programming approach is used to account for uncertainty of solar radiation and wind speed in the design process. A outcome from the uncertainty analysis is that solar-wind-battery system cannot be designed to provide power supply reliability beyond a maximum value.