

Sayyad Nojavan, Majid Majidi, Kazem Zare, 2017, Performance improvement of a battery/PV/fuel cell/grid hybrid energy system considering load uncertainty modeling using IGDT, *Energy Conversion and Management*, Volume 147, #1 pp.29–39.

### Highlights

1. Optimum performance of PV/battery/fuel cell/grid hybrid system under load uncertainty.
2. Employing information gap decision theory (IGDT) to model the load uncertainty.
3. Robustness and opportunity functions of IGDT are modeled for risk-averse and risk-taker.
4. Robust strategy of hybrid system's operation obtained from robustness function.
5. Opportunistic strategy of hybrid system's operation obtained from opportunity function.

**Abstract** Nowadays with the speed that electrical loads are growing, system operators are challenged to manage the sources they use to supply loads which means that besides upstream grid as the main sources of electric power, they can utilize renewable and non-renewable energy sources to meet the energy demand. In the proposed paper, a photovoltaic (PV)/fuel cell/battery hybrid system along with upstream grid has been utilized to supply two different types of loads: electrical load and thermal load. Operators should have to consider load uncertainty to manage the strategies they employ to supply load. In other words, operators have to evaluate how load variation would affect their energy procurement strategies. Therefore, information gap decision theory (IGDT) technique has been proposed to model the uncertainty of electrical load. Utilizing IGDT approach, robustness and opportunity functions are achieved which can be used by system operator to take the appropriate strategy. The uncertainty modeling of load enables operator to make appropriate decisions to optimize the systems operation against possible changes in load. A case study has been simulated to validate the effects of proposed technique.

**Keywords** Information gap decision theory (IGDT); Hybrid system; Fuel cell; Battery storage; Photovoltaic system (PV); Heat storage tank.