Fault tolerant control of energy processes

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Abstract: This work deals with the control of energy systems subject to faults. The objective is toaccommodate faults by the design of a control law that takes into account the existence ofinternal faults and dysfunctions caused by external environment.Energy systems are characterized by the dependence of their performance on energyefficiency, the total efficiency is the result of the operation of elementary energy processesto verify the final objective which is the production of energy in its final form. Thesupervision of these processes and tolerance to faults allow the improvement of individualperformances and the achievement of global efficiency at a lower cost.In this context, renewable energy conversion processes are characterized by the aspect oftheir dependence on climatic conditions and direct exposure to outdoor environment,resulting in the occurrence of different types of faults and dysfunctions. Solar photovoltaicrenewable energy generation systems are considered in this work as they dominaterenewable electricity capacity expansion. The study of the effect of various abnormalevents and degraded operating modes of solar photovoltaic systems is performed and afault-tolerant control law is proposed to enhance the efficiency of these energy processes.A reconfiguration of controller is designed to switch between an improved current-basedparticle swarm optimization technique and the incremental conductance algorithm.Practical implementation of the proposed approach shows excellent performance in realoperating conditions when compared to traditional maximum power point algorithms.

Keywords : fault-tolerant control, energy systems, renewable energy, Solar energy, Photovoltaic, Maximum Power Point Tracking, Particle Swarm Optimization