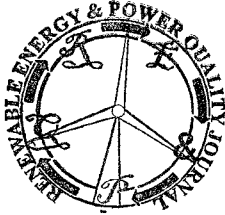


Artificial Intelligence Techniques for Controlling Spacecraft Power System

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Abstract. Advancements in the field of artificial intelligence (AI) made during this decade have forever changed the way we look at automating spacecraft subsystems including the electrical power system. AI have been used to solve complicated practical problems in various areas and are becoming more and more popular nowadays. In this paper, a mathematical modeling and MATLAB–SIMULINK model for the different components of the spacecraft power system is presented. Also, a control system, which includes either the Neural Network Controller (NNC) or the Fuzzy Logic Controller (FLC) is developed for achieving the coordination between the components of spacecraft power system as well as control the energy flows. The performance of the spacecraft power system is evaluated by comparing two control systems using the NNC and the FLC.

Key words

Spacecraft, Neural network, Fuzzy logic control, Photovoltaic array.

1. Introduction

Provision of electrical power for space vehicles is the most fundamental requirement for the satellite payload. Power system failure necessarily results in the loss of a space mission, and it is interesting to note that, many of the early satellite systems failed due to such a loss [1].

In the last three decades, numerous alternative control techniques, such as neural and fuzzy control, have been proposed instead of conventional classical technique. Development of artificial neural networks (ANN's) and fuzzy logic theory have inspired new resources for possible implementation of better and more efficient control. ANN's have capability of learning the dynamical systems that estimated input-output functions. Fuzzy systems transform sets of structured information into the appropriate control actions. Especially, neither ANN's

nor fuzzy systems need mathematical modeling of the plants. Fuzzy control systems can be developed along with linguistic lines and need some expertise information about the plant. On the other hand, before used for control purposes, ANN's have to be trained and they need some information (not based on mathematical model but sometimes taken measurement from plant) about the plant. Generally, input-output characterization or desired output of the plant or neuro controller are sufficient [2, 3].

The emphasis of this paper is concerned with the control of the energy flow of spacecraft power system using either the NN or the FL techniques. The performance of the global system has been studied using MATLAB – SIMULINK.

2. Spacecraft Power System

Photovoltaic conversion of the sun's energy is the most common source of electrical power in space. A typical solar panel–battery power system is shown in Fig. 1 [4, 5].

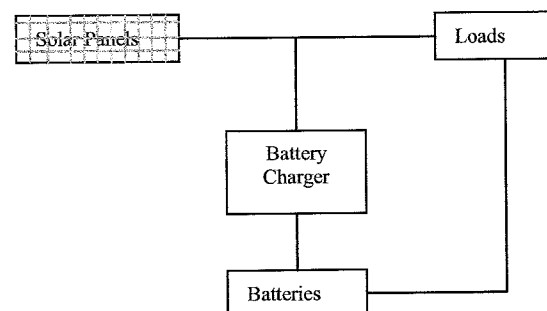


Fig. 1. Typical solar panel–battery system architecture.