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Gas turbine modeling using adaptive fuzzy neural network approach based on measured data classification

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Abstract

The use of gas turbines is widespread in several industries such as; hydrocarbons, aerospace, power generation. However, despite to their many advantages, they are subject to multiple exploitation problem that need to be solved. Indeed, the purpose of the present paper is to develop mathematical models of this industrial system using an adaptive fuzzy neural network inference system. Where the knowledge variables in this complex system are determined from the real time input/output data measurements collected from the plant of the examined gas turbine. It is obvious that the advantage of the neuro-fuzzy modeling is to obtain robust model, which enable a decomposition of a complex system into a set of linear subsystems. On the other side, by focusing on the membership functions for residual generator to get consistent settings based on the used data structure classification and selection, where the main goal is to obtain a robust system information to ensure the supervision of the examined gas turbine.

Keywords: Gas turbine, Adaptive fuzzy neural network, Fuzzy inference modeling, Fuzzy clustering, Data measurements

Background

Gas turbines have become very effective in industrial applications for electric and thermal energy production in several industries. However, these rotating machines systems are complex and they are composed of several sensitive elements that are subject to some defects and operational risks [1–6, 7]. In the literature, several scientific studies have been done as tentative to the model development for the analysis of the dynamic behavior of these types of gas turbine machinery. On the other side, the physical model of a gas turbine can be obtained by dynamic simulations in the conception step, or based on real plant data of these types of machine in exploitation. Indeed, the models developed in the literature screens are complicated and are not exploitable in control strategy [8–13].

The developed model in this paper is reliable and easy to be implemented to ensure the control of the gas turbine system, which can provide a quick and an accurate estimation of the dynamic behavior of the studied gas turbine using the identification techniques based on the fuzzy neural networks. This model can be a suitable choice for the detection and the isolation of faults in gas turbine based on the generation of residues resulting from the comparison of the actual process