Chapter 7
A Comparative Study of Neural Network and Fuzzy Logic Control Based Active Shunt Power Filter for 400 Hz Aircraft Electric Power System

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ABSTRACT

Constant Instantaneous Power Control Strategy for extracting reference currents for shunt active power filters have been modified using Artificial Neural Network & Fuzzy logic control based controller and their performances have been compared. The acute analysis of Comparison of the compensation capability based on THD and speed will be done, and recommendations will be given for the choice of technique to be used. The simulated results using MATLAB model are shown, and they will undoubtedly prove the importance of the proposed control technique of aircraft shunt APF.

1. INTRODUCTION

More advanced aircraft power systems have been needed due to increased use of electrical power on behalf of other alternate sources of energy (Chen Donghua, 2005) (Saifullah & Bharti, 2014) (Saifullah Khalid, Application of AI techniques in implementing Shunt APF in Aircraft Supply System, 2013). The subsystems like flight control, flight surface actuators, passenger entertainment, are driven by electric power, which flowingly increased the demand for creating aircraft power system more intelligent and advanced. These subsystems have extensive increased electrical loads i.e. power electronic devices, increased feeding of electric power, additional demand for power, and above to all of that great stability problems.

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In peculiarity to standard supply system, the source frequency is of 50 Hz, whereas, aircraft AC power system works on the source frequency of 400 Hz (Chen Donghua, 2005) (Saifullah & Bharti, 2014) (Saifullah Khalid, Application of AI techniques in implementing Shunt APF in Aircraft Supply System, 2013). Aircraft power utility works on source voltage of 115/200V. The loads applicable to the plane a system differs from the loads used in 50 Hz system (Chen Donghua, 2005). When we deliberate the generation portion; aircraft power utility will remain AC driven from the engine for the plane primary power. Novel fuel cell technology can be used to produce a DC output for ground power, and its silence process would match up to suitably with the Auxiliary Power Unit (APU). Though when considering the dissemination of primary power, whether AC or DC; each approach has its merits. In DC distribution, HVDC power distribution systems permit the most resourceful employ of generated power by antithetical loss from skin effect. This allows paralleling and loads sharing amongst the generators. In AC distribution, AC Flogging is very clear-cut at high levels too. Due to its high dependence on HVDC system, a wide range of Contactors, Relays can be exploited.

While talking about Aircraft Power Systems we also need to consider increased power electronics application in aircraft which creates harmonics, large neutral currents, waveform distortion of both supply voltage and current, poor power factor, and excessive current demand. Besides if some non-linear loads is impressed upon a supply, their effects are additive. Due to these troubles, there may be nuisance tripping of circuit breakers or increased loss and thermal heating effects that may provoke early component failure. This is a prodigious problem to every motor loads on the system. Hence, decent power quality of the generation system is of scrupulous attention to the Aircraft manufacturer. We discern that aircraft systems work on high frequency so even on the higher frequencies in the range of 360 to 900Hz; these components would remain very significant.

Today, advanced soft computing techniques are used widely in the involuntary control system, and optimization of the system applied. Several of them are such as fuzzy logic (Guillermin, 1996) (Abdul Hasib, Hew Wooi, A, & F., 2002) (Jain, Agrawal, & Gupta, 2002) (Norman, Samsul, Mohd, Jasronita, & B., 2004) (Afonso J. L., 1998), optimization of active power filter using GA (Chiewchitboon, Tipsuwanpom, Soonthomphisaj, & Piyarat, 2003) (Kumar & Mahajan, 2009) (Ismail, Abdeldjebar, Abdelkrim, Mazari, & Rahli, 2008) (Wang, Zhang, XinheXu, & Jiang, 2006), power loss reduction using particle swarm optimization (Thangaraj, Thanga, Pant, Ajit, & Grosan, 2010), Artificial neural network control (P, K, & Eduardo, 2001) (Rajasekaran, 2005) (Rojas, 1996) (Zerikat & Chekroun, 2008) (Seong-Hwan, Tae-Sik, YooJi-Yoon, & Gwi-Tae, 2001) applied in together machinery and filter devices.

In this paper, ANN and Fuzzy Logic control based controller together have been used to mend the complete performance of active filter for the lessening of harmonics and other delinquents created into the aircraft electrical system because of the non-linear loads (Chen Donghua, 2005). The simulation results clearly show their effectiveness. The simulation results acquired with the new model are much improved than those of traditional method.

The paper has been modified in a sequential manner. The APF outline and the load under contemplation are discussed in Section 2. The control algorithm for APF converses in Section 3. MATLAB/Simulink based simulation results are presented in Section 4, and finally Section 5 concludes the paper.