Chapter 1
ANFIS-SCC Control of Shunt Active Power Filter for Minimization of Harmonics for More Electric Aircraft System

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ABSTRACT

A growth of computational intelligence techniques is the motivation to propose an intelligent controller in this chapter to minimize the harmonics in a more electric aircraft systems due to the presence of nonlinear load applied in aircraft system. Conventional PI controller is implemented in the system and the compensated reference current is generated by sinusoidal current control theory. Shunt active power filter is mainly used to minimize the harmonics in the aircraft system feeding the nonlinear load. The proposed system uses conventional SCC- and ANFIS-based controller and the results are compared. The simulation result of total harmonic distortion (THD) is demonstrated through MATLAB/SIMULINK.

INTRODUCTION

Aircraft ac power systems form middle and small power utility, deploying three-phase four-wire systems having an operating frequency of 400Hz (Chen Donghua, 2005). With the more electronic applications being used in aircraft, current harmonics and unbalances become inevitable to become accountable for the increase of losses and low power supply performance. The harmonics can also cause malfunctions of sensitive apparatus and create significant interference with communication circuits creating hazards (Chen Donghua, 2005).

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Unluckily, power electronic loads have an inherently nonlinear nature, and they, therefore, draw a distorted current from the mains supply (Maoh-Chin Jiang, 2012). That is, they draw non-sinusoidal current, which is not in proportion to the sinusoidal voltage. Due to this reason, the utility providing supply to these loads has to offer large reactive volt-amperes (Sachine, 2007) (Saifullah khalid, 2013). Also, the harmonics generated by the load distorts it., These electronic converters draw harmonic and VAR component of current from ac mains (S.Khalid, 2009)(Situations, 1996). The insertion of harmonics, the additional load of reactive power burden, unbalance, and excessive neutral current cause low system efficiency and lousy power factor. They also cause disturbance to other applications and interference with nearby communication networks (Etezadi-Amoli, 1990), overheating in transmission and distribution facilities, miscalculation, and malfunction of utility relays. The enforced tariffs levied by utilities toward excessive VARs and the danger of more stringent harmonic norms resulted in the intensive survey (Jacobina, 2001) to quantify the problems associated with electric power networks having nonlinear loads (Caseiro, 2009) i.e., the load compensation techniques for power quality improvement.

Using active shunt filters in aircraft can remove the harmonic, reactive, and unbalanced currents, improve the power supply performance and the stability of the system (Chen Donghua, 2005). The active filter, which effectively injects compensating currents into the ac line, has the following characteristics that make it an appealing approach to other techniques.

1. All the harmonics generated due to the converters can be compensated by one piece of equipment (G.-H., 1992).
2. The maximum order of harmonic to be suppressed has no theoretical limit and is determined by the switching pattern of the active filters (G.-H., 1992).

If harmonics components change in magnitude or frequency, this can be accommodated by control adjustment rather than costly equipment changes (Gyu-Ha, 1991).

In this chapter, An adaptive neuro-fuzzy inference system or adaptive network-based fuzzy inference system (ANFIS) has been applied for the reduction of harmonics and other downside generated into aircraft systems attributable to the nonlinear loads (Chen Donghua, 2005). The results obtained with ANFIS Control based scheme are far better than the Sinusoidal current control strategy. The results of the simulation have shown the effectiveness of the planned system. The result has justified its efficacy.

In this chapter, ANFIS control has replaced the PI controller used in the dc control voltage loop. The controlling theme was modeled on the notion of the current Sinusoidal Control Strategy. The chapter has been organized in the following manner. The Active Power Filter configuration and the load into consideration, the control algorithm for Active Power Filter, and lastly, MATLAB/ Simulink based mostly simulation results are presented.

BACKGROUND

When one of the initial models based on instantaneous reactive power theory was reported, active filters had been advanced, The application of this technique allows compensating independently the average or oscillating portions of the active (real) and reactive (imaginary) powers. One of the complications of the controllers based on the well-known PQ Theory is the practice of low-pass filters to distinct the average and oscillating portions of powers.