Chapter 12
Application of Adaptive Tabu Search Algorithm in Hybrid Power Filter and Shunt Active Power Filters: Application of ATS Algorithm in HPF and APF

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ABSTRACT
A novel hybrid series active power filter to eliminate harmonics and compensate reactive power is presented and analyzed. The proposed active compensation technique is based on a hybrid series active filter using ATS algorithm in the conventional Sinusoidal Fryze voltage (SFV) control technique. This chapter discusses the comparative performances of conventional Sinusoidal Fryze voltage control strategy and ATS-optimized controllers. ATS algorithm has been used to obtain the optimum value of Kp and Ki. Analysis of the hybrid series active power filter system under non-linear load condition and its impact on the performance of the controllers is evaluated. MATLAB/Simulink results and Total harmonic distortion (THD) shows the practical viability of the controller for hybrid series active power filter to provide harmonic isolation of non-linear loads and to comply with IEEE 519 recommended harmonic standards. The ATS-optimized controller has been attempted for shunt active power filter too, and its performance has also been discussed in brief.

INTRODUCTION
Over the years, there has been an incessant proliferation of nonlinear type of loads due to the rigorous use of power electronic control in all branches of industry as well as by the ordinary consumers of electric energy (Aredes, 1991; Moran, 1995; Maniya, 2013; Ruminot, 2006). This solid state control of AC power using thyristors and other semiconductor switches is extensively used to feed controlled electric power

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Unfortunately, power electronic loads have an intrinsically nonlinear nature, and they, therefore, draw a distorted current from the mains supply. Specifically, they draw non-sinusoidal current, which is not in proportion to the sinusoidal voltage. Consequently, the utility supplying these loads has to offer large reactive volt-amperes. Also, the harmonics produced by the load pollutes it. As nonlinear loads, these solid-state converters draw harmonic and reactive power part of the current from AC mains. Figure 1 shows the distorted currents passing through the linear, series impedance of the power distribution system.

The problem, which has been seen while using non-linear loads, is injected harmonics, reactive power burden, unbalance and excessive neutral current. Due to them, also to poor power factor, system’s efficiency has also been reduced drastically. They also cause disturbance to other consumers and interference in nearby communication networks, excessive heating in transmission and distribution equipment, errors in metering and malfunctioning of utility relays. The inflicting tariffs levied by utilities against excessive VARs, and the threat of stricter harmonics standards have led to extensive surveys to quantify the problems associated with electric power networks having nonlinear loads. i.e. the load compensation techniques for power quality improvement.

To remove these problems, passive filters has been formulated, but they are designed to compensate selected harmonic components, so some harmonics are always there. The passive filter not only affects inverter harmonic injection but forces on the harmonics created by a joined nonlinear load. There are numerous techniques for controlling harmonic current flow, for example, DC ripple injection, harmonic current injection, series and parallel active filter systems, magnetic flux compensation. Passive harmonic filters are frequently employed to decrease current distortion and voltage harmonics in distributed generation systems.

The shunt passive filters expose lower impedance at tuned harmonic frequency than the source impedance so that reduced harmonic currents flow into the source (Rubén, 2005). However, the filtering

Figure 1. Harmonic voltages at the PCC due harmonic currents