摘要

電焊機、壓縮機、電弧爐等負載變動或大型馬達啟動所需的無效電力會造成匯流排的電壓變動，一般的電壓調整裝置譬如變壓器的有載分接頭是無法配合如此的急促變化作適當的電壓調整。當此電壓急促變動的幅度和頻率達到某一界限，由此匯流排引接的饋線上用戶照明設備會出現忽明忽暗的變化，進而引起視覺上的不舒服，此現象稱為「電壓閃爍」。

國際間 IEC-61000-4-15 與ΔV_{10}等規範可用於評估電壓閃爍的嚴重程度。國內目前採用ΔV_{10}，諸多商用量測儀器採用離散傅立葉轉換，作為頻譜分析與ΔV_{10}的計算工具，但其洩漏效應卻影響離散傅立葉轉換的精確準度。為解決離散傅立葉轉換的問題，近年來的文獻提出多個方法諸如：間接解調法、卡門濾波器法、最小絕對值估測法、離散小波轉換法、連續小波變換法、ADALINE 法、Hilbert 法等。

本論文針對其中的間接解調法、離散小波同步檢測法、Hilbert 轉換檢測法及 ADALINE 檢測法等四個方法進行比較，並與商用的監測儀 ADX 3000 之檢測值相比對，根據四個方法的原理以及電壓閃爍的實測頻譜特性，分析四個方法應用之準確度、計算速度與雜訊免疫程度，並得以下結論：(1) Hilbert 轉換檢測法、間接解調法之計算速度、準確度與雜訊免疫程度皆稱良好，於線上應用頗具有潛力；(2) 離散小波同步檢測法在硬體實現上須要搭配同步信號檢測，否則當系統頻率變動時不利於估測準確度；(3) 由於 ADALINE 檢測法適用於頻率較低的閃爍成分，測試於實錄波形，準確度尚佳。

Abstract

The reactive power variation due to the heavy load change in the process of arc welding, compressor or arc furnace operation, or large motor starting, can lead to voltage fluctuation on the power system bus. Most voltage regulation equipment cannot respond effectively to this rapid change. When the amplitude and frequency of the fluctuation exceed the critical value, the illumination source at the same bus will flicker and hence bring vision discomfort. This phenomenon is called the voltage flicker.

The IEC-61000-4-15 and ΔV_{10} are standards commonly known for evaluation of the severity of voltage flicker. The latter is the one presently adopted in Taiwan. Most flickermeters utilize the discrete Fourier transform to analyze the flicker frequency spectrum for ΔV_{10} evaluation. However, the leakage effect of discrete Fourier transform can reduce the measurement accuracy. To overcome this limitation, many other detection methods have been proposed, such as the indirect demodulation, the Kalman filter, the least absolute value, the discrete wavelet synchronous detection, the continuous wavelet, the Hilbert transform, and the adaptive linear neuron(ADALINE) methods etc..

In this thesis, four of the detection methods, including the indirect demodulation, the discrete wavelet synchronous detection, the Hilbert transform, and the ADALINE, are evaluated and compared with a commercial power analyzer, the ADX 3000. The accuracy, stability and computational speed of four methods in their application are explored on their sample test results, theoretical features and the spectrum characteristic of flicker field measurement. The test results show that : (1) the Hilbert transform and the indirect demodulation are good at their computational speed、detection accuracy and noise immunity, thus having potential in on-line application; (2) when system frequency deviates, the discrete wavelet could have difficulty in its detection accuracy, unless an accurate synchronization signal can be generated by the hardware; (3) the ADALINE, due to its adaptability to the low frequency flicker components, when tested on the field data, is pretty good at its detection accuracy.