HARDWARE IMPLEMENTATION OF A

POWER SYSTEM STABILIZER

H.C.S. HETTIGODA

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DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

Abstract

The aim of this project is to implement a Power System Stabilizer (PSS) and incorporate it to a Generator to enhance its dynamic performance. When a generator is connected to a power system the rotor angle oscillations due to small load changes can be observed This is due to fact that once a generator is constructed the damping effect of it is fixed and it is unable to offer additional damping to damp down these rotor angle oscillations. The power system stabilizer (PSS) provides supplementary damping for low frequency rotor angle oscillations ranging from 0.1 Hz to 3 Hz which covers local mode, Inter area mode and inter unit mode power system oscillations. Here the PSS output is fed back to the excitation system summing point to damp down rotor angle oscillations.

In general, small load changes in a power system cause rotor angle oscillations. In order to damp down these oscillations an electrical torque should be produced on the rotor shaft, in phase with the speed deviation. Power system stabilizer adds a closed loop auxiliary feedback signal to the reference voltage of Automatic voltage regulator (AVR) in proportion to either speed deviation, frequency deviation or power deviation.

Normally the terminal voltage of a generator is adjusted by the AVR after computing the difference between reference voltage and feedback terminal voltage. In my project the PSS is designed to operate as follows. A voltage signal in proportion to the frequency deviation caused by small load changes is first produced. This voltage signal which represents the frequency deviation is then added to the reference voltage of AVR. This in turn causes an electrical torque to be added on the rotor shaft to enhance the small signal stability performance.

The developed PSS consists of a High pass filter (HPF), a Zero crossing detector (ZCD), a Frequency to voltage convertor (F/V), a Summer 1 and a Summer 2. The frequency deviation is filtered by using the HPF in order to block steady changes in frequency. The filtered signal is sent through the ZCD to maintain a constant amplitude signal to the F/V convertor because it responds to amplitude of input signal. The output of F/V convertor and the voltage corresponding to base load frequency which is injected separately using a

Calibration instrument, are summed in summer 1 to obtain a voltage deviation corresponding to frequency deviation. The output of summer 1 and reference voltage of AVR are summed in summer2 and fed back to LM723, which is the main control chip of the AVR.

In order to analyze the effect of PSS, following parameters were observed.

1 Output of frequency to voltage convertor
2 Generator Current
3 Induction Motor Current

Finally two MATLAB routines are used to extract actual low frequency oscillations from observed signals.

1 A low pass filter is designed using ellip() and filter() functions and observed signals are filtered with a cutoff frequency of 3 Hz. The outputs of the filter clearly show the effect of PSS in enhancing the dynamic performance of the generator.

2. Observed signals are analyzed using Fast Fourier transform technique in MATLAB in order to observe the low frequency components.

Preface

Design of a power system stabilizer came into my mind after completion of power system stability module of MEng / PG Diploma course.At tbat time I had only a conceptual idea of power system stabilizer. I gathered more knowledge on Power System Stabilizers by searching the Internet.

I am indebted to Prof. Rohan Lucas, Dr. Jahan Peiris and Dr. Nalin Wickramarachchi for their valuable encouragement and direction to implement this project.

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