Relay with a Negative Hysteresis for Autotuning of Control Systems Under Noisy Environments

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When measurements contain noises, to avoid chattering, relays with positive hysteresis are often used for the relay feedback autotuning of control systems. However, their switching times fluctuate and average switching periods are not those at a given phase angle. Their phase angles are dependent on the oscillation periods and can be found after the relay feedback experiments are done. To find amplitudes of relay feedback oscillations, average values are needed.

Recently, a method which reduces errors in the ultimate gain identification by using integrals of relay feedback responses has been proposed [1]. This integral which reduces the effects of noises can be put in the feedback loop, but its oscillation becomes at the phase angle of $-\pi/2$. The frequency response data at the phase angle of $-\pi/2$ is usually not recommended for tuning of PID controllers. To find frequency responses of phase angles between $-\pi/2$ and $-\pi$, relay with a negative hysteresis [2] is introduced here.

First, we investigate examples showing phase angles appropriate to tune PID controllers [3]. Then we propose a method to obtain the frequency response at the phase angle. For this, relay with a negative hysteresis and the integral element are used. The integral element reduces the effect of noises and the relay with negative hysteresis compensates the phase lag due to the integral element. Typical responses of the proposed relay feedback method are shown as follows.

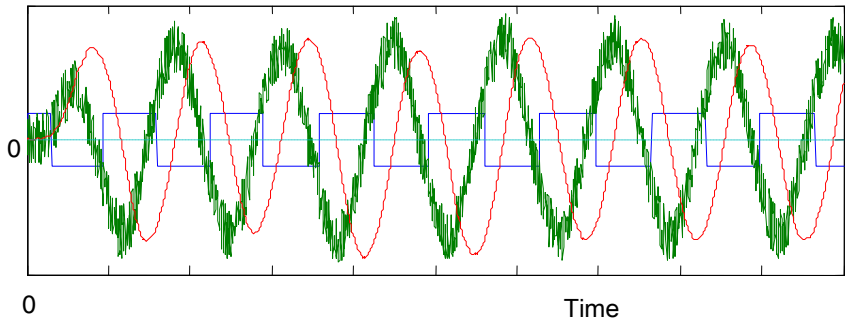

Figure 1. Typical responses of the proposed relay feedback identification.

References

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