Fachhochschule Nordwestschweiz
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Report System Control Laboratory

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1 Operating Basics

1.1 Introduction

To ensure a good understanding of controllers and controlling theory, a laboratory experiment was performed. As the plant, a motor was used whose speed had to be controlled. The step function was measured and analyzed at first. Knowing the step function it was very easy to implement a suitable PID controller.

1.2 Step Function

1.3 Methods to dermine the controller parameters

There is many different approaches to determine the characteristics of the system and design a PID controller accordingly. For this experiment, the two described in the next two Sections were used.

1.3.1 Chien, Hrones, Reswick

To determine the characteristics of the system, a step is applied to the input. Then the output is observed.

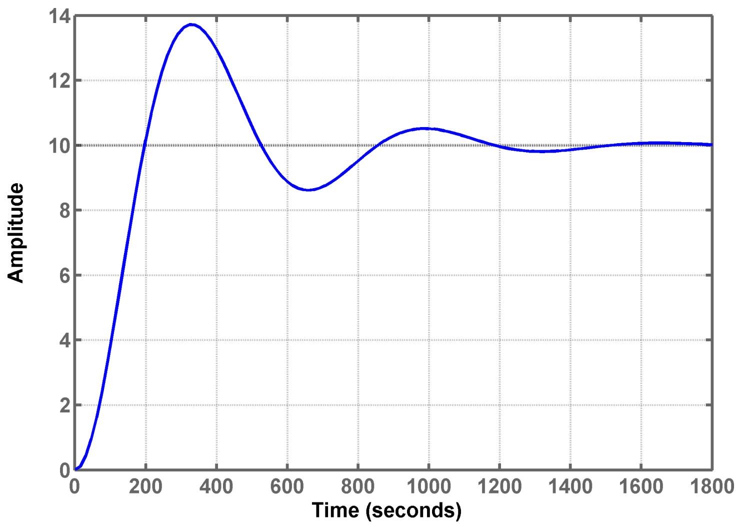

Figure 1: Step response of a PT_2 element

Using the turn tangent principle depicted in Figure 2, the parameters T_u, T_g and K_s were derived.

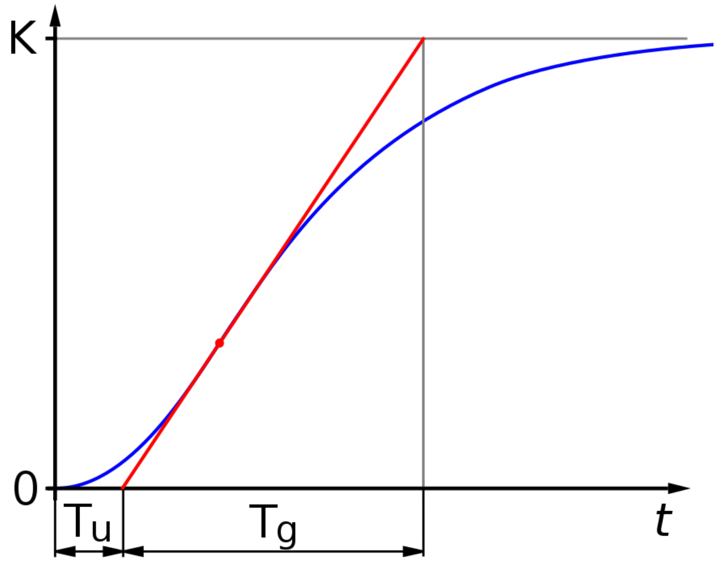

Figure 2: Step response of a PT_2 element

Once those paramters are known, the PID parameters can be calculated as formulated in Table 1.

Controller Type	K_p	T_i	T_d
P	$0.3 * \frac{T_g}{T_u * K_s}$	-	-
PI	$0.35 * \frac{T_g}{T_u * K_s}$	$1.2 * T_g$	-
PID	$0.6 * \frac{T_g}{T_u * K_s}$	T_g	$0.5 * T_u$

Table 1: Chien, Hrones, Reswick Method

1.3.2 Ziegler-Nichols

To use this also called oscillation method the system characteristics are determined by bringing the system to the brink of oscillationby increasing K_p whilst the I and D parts remain zero. The parameters K_u and T_u are then the gain K_p and the period of the oscillating output.

The PID parameters then can be calculated according to Table 2.

Controller Type	K_p	T_i	T_d
P	$0.5 * K_{P.crit}$	-	-
PI	$0.45 * K_{P.crit}$	$0.85 * \tau_{crit}$	-
PID	$0.6 * K_{P.crit}$	$0.5 * \tau_{crit}$	$0.12 * \tau_{crit}$

Table 2: Ziegler-Nichols Method