Model Documentation of the Hysteresis System

1 Nomenclature

1.1 Nomenclature for Model Equations

 $\begin{array}{lll} s_1 & \text{switching treshold down} \\ s_2 & \text{switching treshold up} \\ y_i & \text{output values of the hysteresis system for i} = 1, \, 2 \\ T_{storage} & \text{time constant of the internal linear first order system (PT1)} \\ w & \text{input signal} \\ x_1 & \text{state signal} \\ a_i & \text{auxiliary signals for i} = 1, \, 2, \, 3, \, 4, \, 5 \end{array}$

2 Model Equations

Input Vector:

u = w

Equations:

$$a_1 = \begin{cases} -1, & \text{for } w < 4\\ 0, & \text{for } w \ge 4 \end{cases}$$
 (1a)

$$a_2 = \begin{cases} 0, & \text{for } w < 8\\ 1, & \text{for } w \ge 8 \end{cases} \tag{1b}$$

$$a_3 = a_1 + a_2 + x_1 \tag{1c}$$

$$a_4 = \begin{cases} 0, & \text{for } w < 4 \\ & \text{or } w < 8 \text{ in case w decreased under 4} \\ & \text{and did not rise over 8 since then} \\ 1, & \text{for } w > 8 \\ & \text{or } w > 4 \text{ in case w increased over 8} \\ & \text{and did not sink under 4 since then} \end{cases}$$

$$(1d)$$

$$x_1 = [0, 1]$$
 (1e)

$$a_5 = [2, 11] \tag{1f}$$

Parameters: $s_1, s_2, y_1, y_2, T_{storage}$ Outputs: y

2.1 Exemplary parameter values

Symbol	Value
s_1	4
s_2	8
y_1	2
y_2	11
$T_{storage}$	0.0001

3 Derivation and Explanation

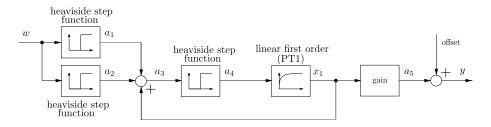


Figure 1: Block Diagram

4 Simulation

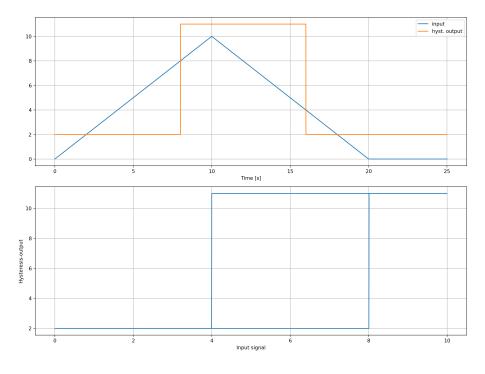


Figure 2: Simulation of the hysteresis system.

References

[1] Knoll, Carsten: Approximation of a simple hysteresis system., Python script published 2021.

 $\verb|https://github.com/TUD-RST/pyblocksim/blob/master/examples/| example-hysteresis.py \\$