Laboratory "Modeling and Simulation of Dynamic Systems"
Institute of the Theory of Electrical Engineering, Measurement and Information Systems, WUT

Exercise No 7B

ADAPTIVE RLS MODEL

Author: S. Osowski, T. Markiewicz

1 The aim of experiments

Learning the properties of the RLS algorithm on the example of identification of dynamic plants using NOI model.

2 Introduction to RLS algorithm

1. Initialization of algorithm

$$\begin{aligned} \mathbf{w}(0) &= \mathbf{0} \\ \mathbf{P}(0) &= \alpha\mathbf{1} \quad (\alpha > 0) \end{aligned}$$

2. The kth iteration (k = 1, 2, ...)

$$\begin{aligned} \mathbf{P}(k) &= \mathbf{P}(k-1) - \mathbf{P}(k-1)\mathbf{x}_k \left[1 + \mathbf{x}_k^T \mathbf{P}(k-1)\mathbf{x}_k\right]^{-1} \mathbf{x}_k^T \mathbf{P}(k-1) \\ \mathbf{w}(k) &= \mathbf{w}(k-1) + \mathbf{P}(k)\mathbf{x}_k \left[\mathbf{d}_k - \mathbf{x}_k \mathbf{w}(k-1)\right] \end{aligned}$$

The Simulink model of this equation is presented in Fig. 1 (file **ad_RLS71.mdl** for version 7 of Matlab). Using this model do the following:

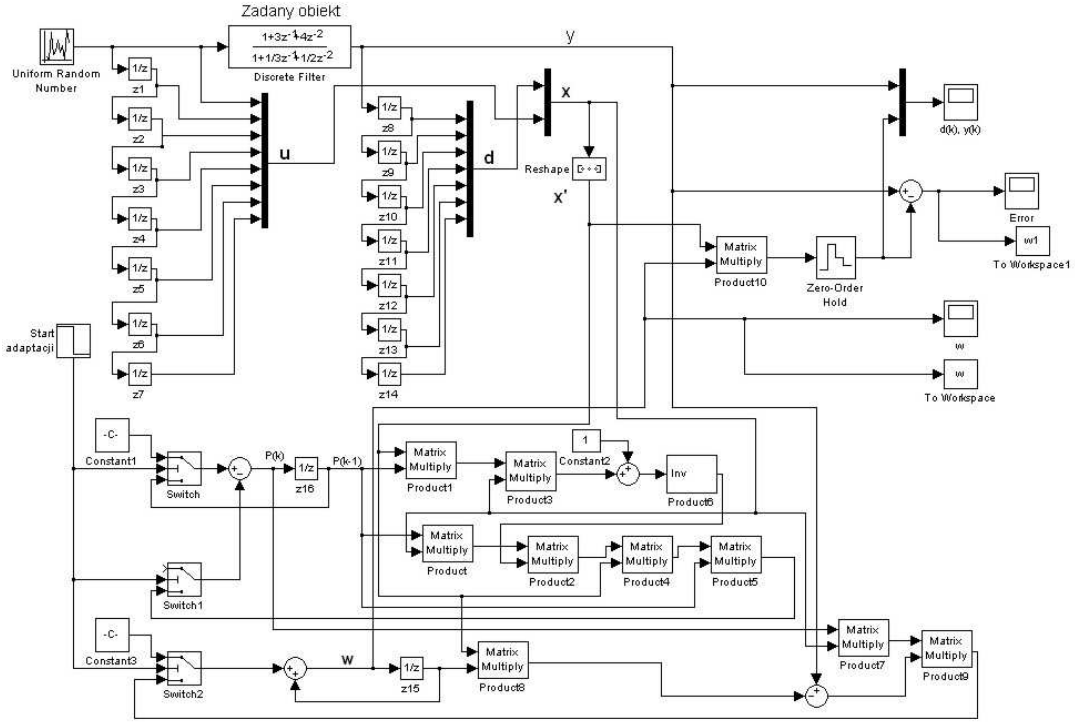

Figure 1: *Simulink model of the RLS algorithm applied in identification task*

1. **NOI plant**

   - Assign the NOI plant for identification of different orders by defining the parameters of the zero-pole form of plant (up to 7th order). Remember of fulfilling the stability conditions of the plant (poles inside the unit circle).
   - For each plant parameters perform the adaptive identification and observe the error of identification. Observe the changes of weigths **w** of the filter in the adaptation process.

- Check the influence of the initial time of the start of the identification using the blok *Start adaptacji* (certain time of running the plant is needed to collect the staring initial past signals of the plant).

2. **SOI plant**

   - Assign the plant in the form of SOI filter of different orders.
   - For each plant parameters perform the adaptive identification and observe the error of identification. Compare the results with the case of NOI plant.
   - Check the influence of the initial time of the start of the identification using the blok *Start adaptacji*