

5. Identification of linear dynamic systems with discrete time

Task 1. /2 points/ For the datafiles *1.txt* and *2.txt*, plot autocorrelation functions (ACF) and partial-autocorrelation functions (PACF). Identify the type of models - autoregressive (AR) or moving-average (MA) - based on ACF and PACF plots.

$$\text{AR}(p): x_k + \alpha_1 x_{k-1} + \dots + \alpha_p x_{k-p} = \beta_0 u_k, \quad (1)$$

$$\text{MA}(q): x_k = \beta_0 u_k + \beta_1 u_{k-1} + \dots + \beta_q u_{k-q}. \quad (2)$$

Task 2. /1 point/ Identify the order of model for the datafiles *1.txt* and *2.txt*, ie. order p for AR model and order q for MA model.

Task 3. /2 points/ Identify autoregressive–moving-average (ARMA) models by least squares method for:

- data without noise (file *3a.txt*),
- data with noise (file *3.txt*).

Identify the orders p and q of ARMA models:

$$\text{ARMA}(p,q): x_k + \alpha_1 x_{k-1} + \dots + \alpha_p x_{k-p} = \beta_0 u_k + \beta_1 u_{k-1} + \dots + \beta_q u_{k-q}. \quad (3)$$

/Total: 5 points/