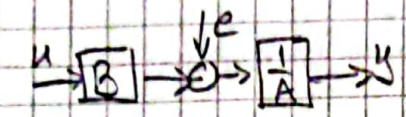
Lab 3 Casper Larsson

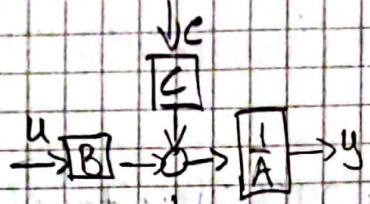
1 ARX with parameters 231 85%, no other gave better result

2a ARX b) BJ

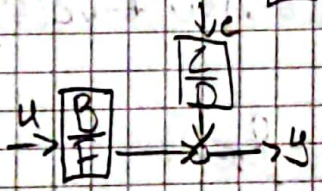
c) ARX:



ARMAX:



BJ:



TSTF => start with ARX, disturbance can follow

ARMAX can handle disturbance better

BJ Model disturbance separately

3 To make sure to be within Nyquist frequency

4 $\tau = 0.1$, $T_s = 20\omega_B = \frac{20}{\tau} = \frac{20}{0.1} = 200$ s

5 As many frequencies as possible, white noise

6

System: $y(t) = u(t-1) + 3u(t-2) + e(t)$ ARX model

Model $y(t) = b_1 u(t-1) + e(t)$

$\hat{\theta} = R_N^{-1} f_N$, $R_N = \frac{1}{N}\sum_{t=1}^{N} \varphi(t)\varphi^T = \frac{1}{N}\sum_{t=1}^{N} u^2(t-1)$

$\Rightarrow \lim_{N\to\infty} R_N = \lim_{N\to\infty} \frac{1}{N}\sum_{t=1}^{N} u^2(t-1) = R_u(0)$

$f_N = \frac{1}{N}\sum_{t=1}^{N} \varphi(t) y(t) = u(t-1)\left(u(t-1) + 3u(t-2) + e(t)\right) =$

$= \frac{1}{N}\sum_{t=1}^{N} \left(u^2(t-1) + 3u(t-1)u(t-2) + u(t-1)e(t)\right)$

$\lim_{N\to\infty} f_N = R_u(0) + 3R_u(1) + \cancel{R_{ue}(1)}$

$\hat{\theta} = \hat{b}_1 = \frac{R_u(0) + 3R_u(1)}{R_u(0)}$

a) $u(t)$ white noise with variance 1 $\Rightarrow R_u(0) = 1$, $R_u(1) = 0$

$\Rightarrow \hat{b}_1 = \frac{1 + 3\cdot 0}{1} = 1$ Svar: $\hat{b}_1 = 1$

b) $R_u(0) = 2$, $R_u(1) = 1$ $\Rightarrow \hat{b}_1 = \frac{2 + 3\cdot 1}{2} = 2.5$

Svar: $\hat{b}_1 = 2.5$