Identifikasi Sistem menggunakan *Genetic Algorithm*

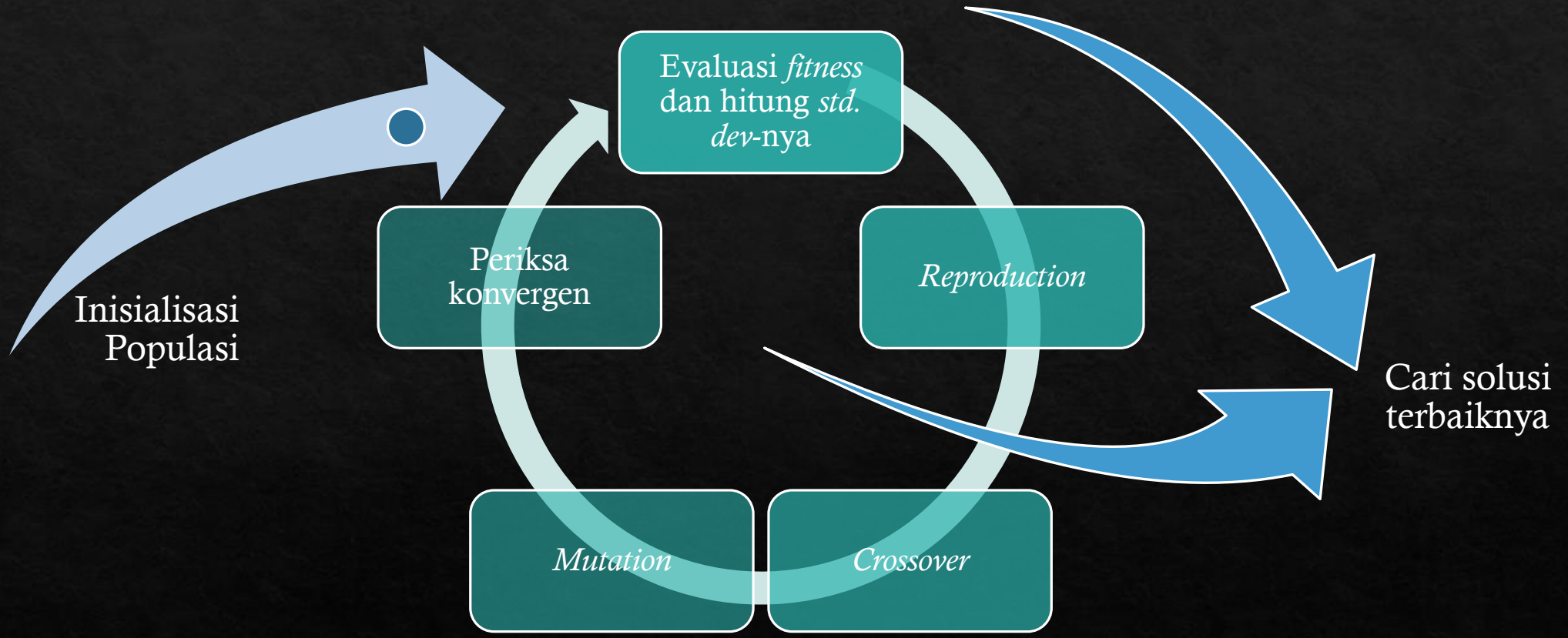
Lintang Erlangga

16/399897/TK/44911

Latar Belakang

- Sulitnya memodelkan suatu *plant*
- Untuk mengestimasi kegagalan dalam pembacaan sensor

Genetic Algorithm



Pemodelan Masalah

State Space Diskrit

$$x[k+1] = Ax[k] + Bu[k]$$
$$y[k] = Cx[k]$$

Pemodelan Masalah

Cuplikan N buah data

$$y[k-N+1] = CAx[k-N] + CBu[k-N]$$
$$y[k-N+2] = CAx[k-N+1] + CBu[k-N+1]$$
$$\dots$$
$$y[k] = CAx[k-1] + CBu[k-1]$$

Pemodelan Masalah

Memodelkan fungsi objektif

$$Y[k] = \begin{bmatrix} y^T[k-N+1] \\ y^T[k-N+2] \\ \vdots \\ y^T[k] \end{bmatrix} \dots \text{(I)}$$

$$\Psi^T[k] = [\psi[k-N+1] \quad \psi[k-N+2] \quad \cdots \quad \psi[k] \dots \text{(II)}$$

$$= \begin{bmatrix} x[k-N] & x[k-N+1] & \cdots & x[k-1] \\ u[k-N] & u[k-N+1] & \cdots & u[k-1] \end{bmatrix}$$

$$Y[k] = \Psi[\mathrm{k}]\Theta[k] + E[k] \dots \text{(III)}$$

$$E[k] = Y[k] - \Psi[\mathrm{k}]\Theta[k] \dots \text{(IV)}$$

Pemodelan masalah

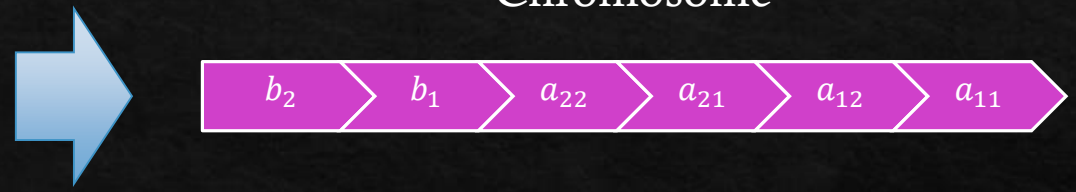
$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

Plant

$$C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$D = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$



Pemodelan Masalah

Tujuan utama

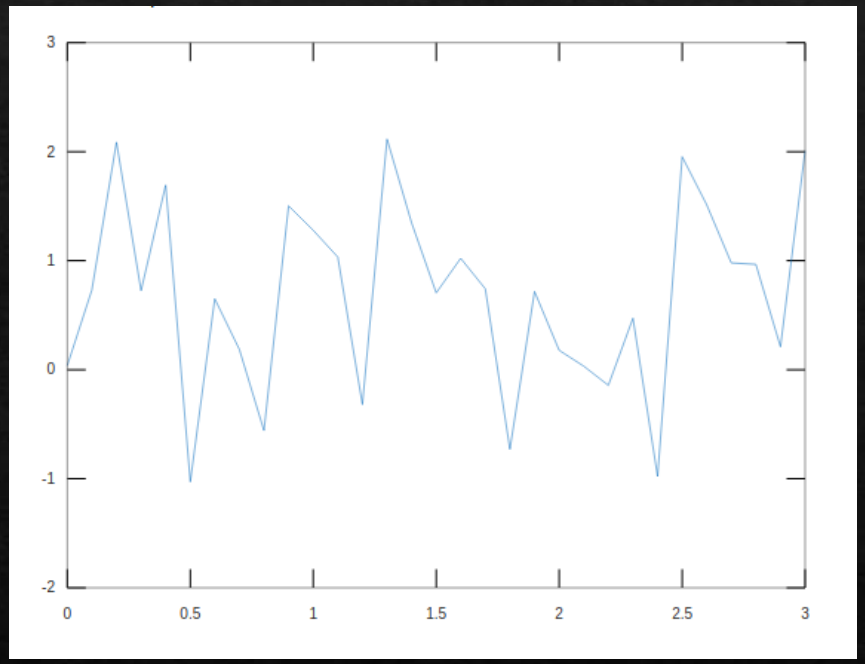
$$\min_{\Theta[k]} \|E[k]\|_2 = \|Y[k] - \Psi[k]\Theta[k]\|_2$$

$$s.t.$$

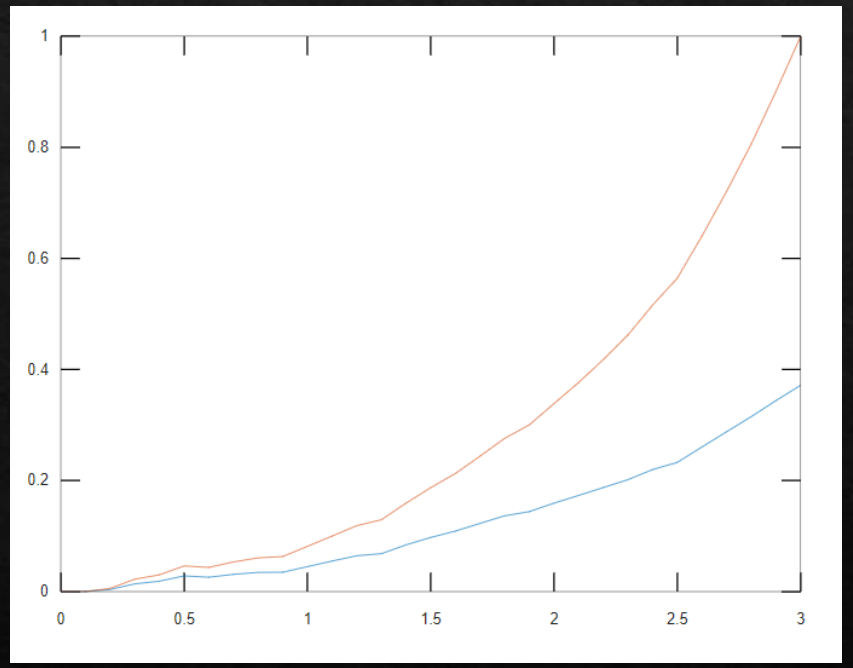
$$D = (a_{11} + a_{22})^2 - 4(a_{11}a_{22} - a_{12}a_{22})$$

$$h(x) = \begin{cases} \sqrt{\left(\frac{a_{11} + a_{22}}{2}\right)^2 + \frac{D}{4}} < 1, & D < 0 \\ \left|\frac{(a_{11} + a_{22})^2 + \sqrt{D}}{2}\right| < 1 \cap \left|\frac{(a_{11} + a_{22})^2 - \sqrt{D}}{2}\right| < 1, & D \geq 0 \end{cases}$$

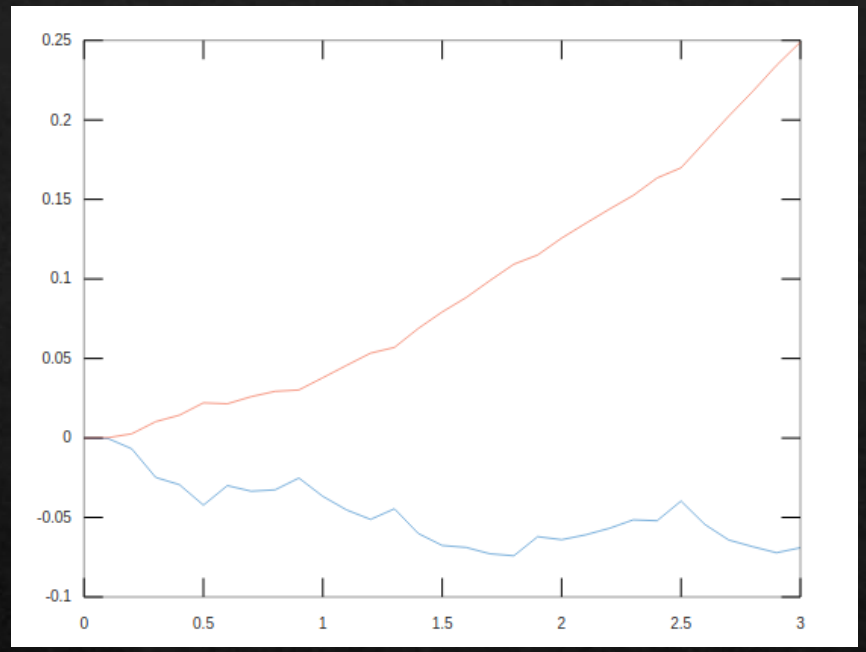
Hasil



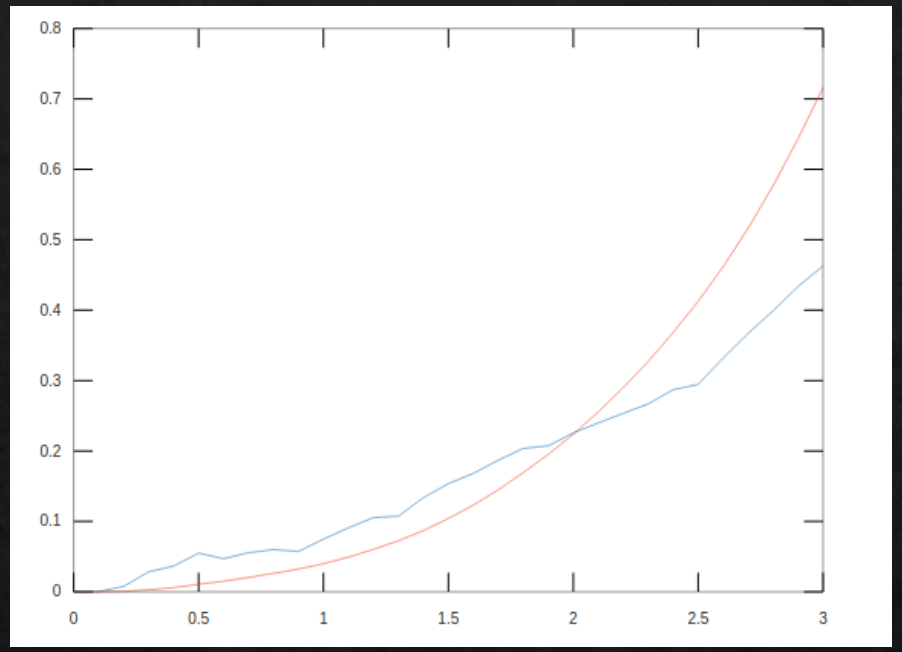
Input



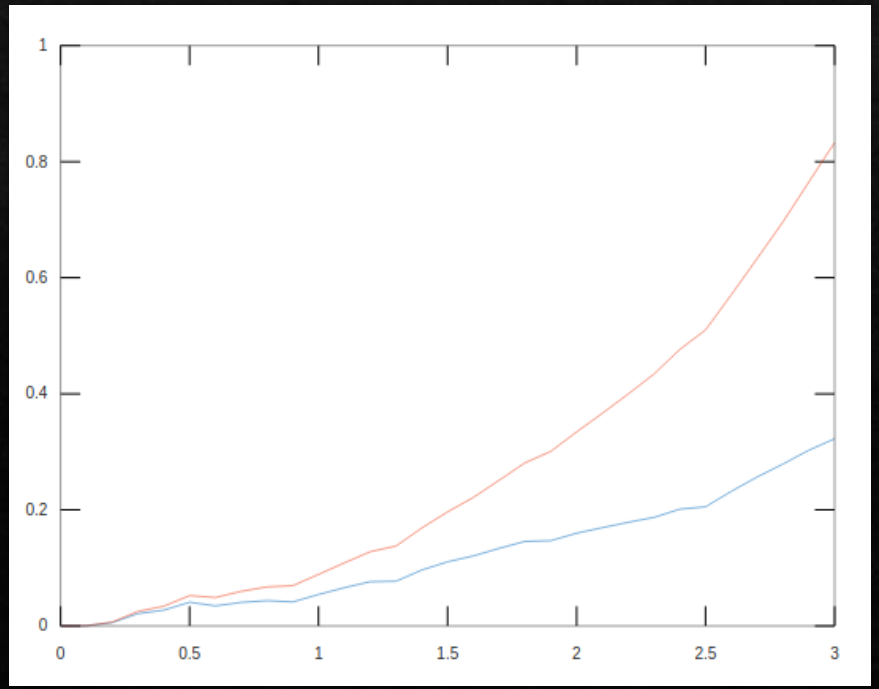
Output Plant



Estimasi 1



Estimasi 2



Estimasi 3

Pengembangan Lebih Lanjut

- Implementasi terbatas pada sistem SIMO dan 2 state
- Matriks output harus *square*
- Interval *random* masih diatur manual
- https://github.com/koseng-lc (Lintang)

Referensi

[1] S.S. Rao, “Optimization Engineering Theory and Practice”, Hoboken. NJ: Wiley, 2009.

[2] E.M. Cimpoeşu, B.D. Ciubotaru and D. Stefanoiu, “Fault detection and identification using parameter estimation techniques”, UPB Scientific Bulletin, Series C: Electrical Engineering and Computer Science, 2014, vol. 76, page 3-14.