EX. 6 → EX. 3 LINEAR PREDICTION
(SYSTEM IDENTIFICATION)

$$y_M(k) = \sum_{k=0}^{N-1} h(k)\, u(n-k) = \begin{bmatrix} u(n) & u(n-1) & \cdots & u(n-N+1) \end{bmatrix} \begin{bmatrix} h(0) \\ h(1) \\ \vdots \\ h(N-1) \end{bmatrix}$$

- AT START OF MEASUREMENT

$$y_M(0) = h(0)\,u(0)$$
$$y_M(1) = h(0)\,u(1) + h(1)\,u(0)$$
.... ETC.

$\underline{\underline{\Phi}} =$ 

- AFTER WAITING OUT TRANSIENTS:

$$y_M(n) = h(0)\,u(n) + h(1)\,u(n-1) + \cdots + h(N-1)\,u(n-N+1)$$

(CONT.)

$\underline{\underline{\Phi}} =$ 

EX. 7 SIGNAL SMOOTHING
(WEIGHTED REGULARIZATION)

$$y(k) = u(k) + n_y(k)$$

SMOOTHING: ENERGY OF DERIVATIVE ↑↓

$$x'(k) = x(k) - x(k-1)$$
$$x''(k) = x'(k) - x'(k-1) = x(k) - 2x(k-1) + x(k-2)$$

$$\min_{\underline{u}} \|\underline{y} - \underline{u}\|_2^2 + \lambda \|\underline{\underline{D}}\,\underline{u}\|_2^2$$

$$\underline{\underline{D}} = \begin{bmatrix} 1 & -2 & 1 & 0 & \cdots & 0 \\ 0 & 1 & -2 & 1 & & \vdots \\ \vdots & & 0 & 1 & -2 & 1 \\ \vdots & & & \ddots & \ddots & \vdots \\ 0 & \cdots & & 0 & 1 & -2 & 1 \end{bmatrix}$$

$$\hat{\underline{u}} = (\underline{\underline{I}} + \lambda \underline{\underline{D}}^T \underline{\underline{D}})^{-1} \underline{y}$$ → Matlab exercises

EX. 8 DECONVOLUTION

$$y(n) = \sum_{k=0}^{N-1} h(k)\, u(n-k) + n_y(k)$$

↑ MEASURED ↑ KNOWN ↓ ESTIMATED

$$\underline{\underline{\Phi}} = \begin{bmatrix} h(0) & 0 & \cdots & 0 \\ h(1) & h(0) & & \vdots \\ \vdots & h(1) & \ddots & 0 \\ h(N-1) & \cdots & h(1) & h(0) \end{bmatrix} \qquad \underline{\theta} = \begin{bmatrix} u(0) \\ u(1) \\ \vdots \\ u(N-1) \end{bmatrix}$$

(CONT.)