$$\mathrm{cov}\left(\mathrm{vec}\left(\hat{\underline{\underline{G}}}(j\omega_k)\right)\right) = \mathcal{E}\left\{ \begin{bmatrix} \square^1 & \square^2 & \cdots & \square^M \end{bmatrix} \right.$$

$$\left. \mathcal{E}\begin{bmatrix} G_{11} \\ G_{21} \\ \vdots \\ G_{N1} \end{bmatrix} \begin{bmatrix} \bar{G}_{11} \bar{G}_{21} \cdots \bar{G}_{N1} \end{bmatrix} \right\}$$

$$\mathcal{E}\left\{ \hat{G}_{k1} \bar{\hat{G}}_{\ell 1} \right\}$$

IN=1
DIFFERENT OUTPUTS

$$\mathcal{E}\left\{ \hat{G}_{k2} \bar{\hat{G}}_{\ell 1} \right\}$$

DIFFERENT INPUTS
DIFFERENT OUTPUTS

$$\begin{bmatrix} \mathrm{var} & \mathrm{corr} & \cdots \\ \mathrm{var} & \ddots & \\ \mathrm{corr} & & \mathrm{var} \end{bmatrix}$$

$n_u = n_y = 2$ CASE

$$\mathcal{E}\left\{ \begin{bmatrix} \hat{G}_{11} \\ \hat{G}_{21} \end{bmatrix} \begin{bmatrix} \bar{\hat{G}}_{11} & \bar{\hat{G}}_{21} \end{bmatrix} \begin{bmatrix} \bar{\hat{G}}_{12} & \bar{\hat{G}}_{22} \end{bmatrix} \right\}$$

$$\rightarrow \mathcal{E}\left\{ \begin{bmatrix} |\hat{G}_{11}|^2 & \hat{G}_{11}\bar{\hat{G}}_{21} & \hat{G}_{11}\bar{\hat{G}}_{12} & \hat{G}_{11}\bar{\hat{G}}_{22} \\ \hat{G}_{21}\bar{\hat{G}}_{11} & |\hat{G}_{21}|^2 & \cdots & \cdots \\ \cdots & \cdots & \ddots & \cdots \\ \cdots & \cdots & \cdots & |\hat{G}_{22}|^2 \end{bmatrix} \right\}$$

$$\mathrm{cov}\left(\mathrm{vec}\left(\hat{\underline{\underline{G}}}(j\omega_k)\right)\right) = \left(\overline{\underline{\underline{U}}_0(k)\underline{\underline{U}}_0^*(k)}\right)^{-1} \otimes \left(\underline{\underline{V}}(k)\,\underline{\underline{C}}_z(k)\,\underline{\underline{V}}^*(k)\right)$$

$$\underline{\underline{V}}(k) = \begin{bmatrix} \underline{\underline{I}}_{n_y} & -\underline{\underline{G}}_0(j\omega_k) \end{bmatrix} \qquad \underline{\underline{C}}_z(k) = \begin{bmatrix} \underline{\underline{C}}_y(k) & \underline{\underline{C}}_{yu}(k) \\ \underline{\underline{C}}_{yu}^*(k) & \underline{\underline{C}}_u(k) \end{bmatrix}$$

SENSITIVE TO CONDITION NUMBER

NOISE COVARIANCE MATRICES FOR 1 EXPERIMENT

$$\mathrm{cond}\left(\underline{\underline{U}}_0\underline{\underline{U}}_0^*\right) = \left(\mathrm{cond}\left(\underline{\underline{U}}_0\right)\right)^2$$

INPUT SIGNALS

- (RANDOM) MULTISINES — LESS EFFORT (PERIODIC)
- RANDOM SIMULTANOUS SIGNALS — LEAKAGE (WINDOWING); INCREASED AVERAGING

$$\left(\hat{G} = \frac{\hat{\Phi}_{yu}}{\hat{\Phi}_u} \right)$$

PERIODIC ≡ CONSTANT
RANDOM ≡ RANDOM