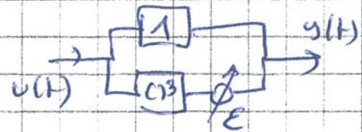
WEAKLY NONLINEAR SYSTEMS

6 2

$$y(t) = u(t) + \varepsilon u^3(t)$$



INPUT SPACE?

INPUT SIGNAL?

$$\hat{G}_{BLA} = \frac{\mathcal{E}\{y(t)u(t)\}}{\mathcal{E}\{(u(t))^2\}}$$

(A) $u(t) \sim N(0, \sigma^2)$

$$\hat{G}_{BLA} = \frac{\sigma^2 + 3!!\,\varepsilon\,\sigma^4}{\sigma^2} = 1 + 3\varepsilon\sigma^2$$

$$y(t) = \underbrace{G_{BLA}(q)\,u(t)}_{(1+3\varepsilon\sigma^2)\,u(t)} + \underbrace{y_s(t)}_{\varepsilon\left(u^3(t) - 3\sigma^2 u(t)\right)}$$

ERROR ON LINEAR MODEL

INPUT DEPENDENT

$\varepsilon = 0.01$ $\quad\sigma^2 = 1$ $\quad G_{BLA} = 1.03$ $\quad$ 3%

$\sigma^2 = 10$ $\quad G_{BLA} = 1.3$ $\quad$ 30%

(B) $u(t) \sim$ uniform on $[-A, A]$ with height $1/2A$

$$\hat{G}_{BLA} = 1 + \frac{3}{5}\varepsilon A^2$$

$A^2 = \sigma^2 = 1$ $\quad$ 0.6%

$A^2 = \sigma^2 = 10$ $\quad$ 6%

"WELL BEHAVING" NONLINEAR SYSTEMS TO MODEL NONLINEAR DISTORTIONS

— " — " — INPUT SIGNALS COVERING MUCH OF INPUT SPACE

TAYLOR SERIES OF ANALYTIC FUNCTION

$$y(t) = f(u(t)) = y_0(t) + \frac{1}{1!}\left.\frac{dy}{du}\right|_{u_0(t)} (u(t) - u_0(t)) \quad \text{LINEAR TERM}$$

$$+ \frac{1}{2!}\left.\frac{d^2y}{du^2}\right|_{u_0(t)} (u(t) - u_0(t))^2 + \ldots \quad \text{HIGHER ORDER TERMS}$$