15-2 Electronic Feedback Systems

Blackboard 15.1

Describing Functions
Linear:
\[ v_{in} = \frac{g_0}{g(w)} v_{in}(w+\epsilon) \]
Nonlinear:
\[ v_{in} = E \sin \omega t \rightarrow NL \rightarrow v_o \]
\[ v_o = B \sin \omega t + A_1 \cos \omega t + A_2 \cos 2\omega t \]
\[ G_v(E, \omega) = \frac{\alpha \cdot B^2}{E} \]
\[ |G_v(E, \omega)| = \frac{\alpha \cdot B^2}{E} \]

Harmonic Distortion:
\[ |a(\nu^3)| \]
\[ |a(\nu^3)| = 0.051 \]
\[ \text{distortion} \approx 2\% \]
Describing-function analysis offers a way to apply the powerful frequency-domain methods that are so useful in linear-systems analysis to nonlinear systems. The describing function indicates the gain-and-phase shift that a nonlinear element provides to an input sinusoid, considering only the fundamental component of the output.

While describing-function analysis can be used to estimate the magnitudes of all signals in a nonlinear system that is driven with a sinusoid, the computational requirements for this type of detailed analysis are generally not justifiable. However, describing functions do provide a valuable way of estimating the amplitude, frequency, and harmonic distortion of certain kinds of oscillators.

Textbook: Sections 6.3 through 6.3.3.

Reading

Problems

Problem 15.1 (P6.6)

Problem 15.2 (P6.7)