

Signals and Systems

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SIGNAL ENERGY AND POWER

If $v(t)$ and $i(t)$ are respectively the voltage and current across a resistor with resistance R , then the instantaneous power is

$$p(t) = v(t)i(t) = \frac{1}{R} v^2(t)$$

The total energy expended over the time interval $t_1 \leq t \leq t_2$ is

$$\int_{t_1}^{t_2} p(t) dt = \int_{t_1}^{t_2} \frac{1}{R} v^2(t) dt$$

And the average power over this time interval is

$$\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} p(t) dt = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{1}{R} v^2(t) dt$$

We use similar terminology for power and energy for any continuous-time signal $x(t)$ or any discrete-time signal $x[n]$. Moreover we can consider signals that take on complex values. In this case the total energy:

$$\int_{t_1}^{t_2} |x(t)|^2 dt \quad \text{where } |x| \rightarrow \text{magnitude of complex } x$$

The total energy in a discrete-time signal $x[n]$ over $n_1 \leq n \leq n_2$ is defined as:

$$\sum_{n=n_1}^{n_2} |x[n]|^2$$

Average power:

$$\frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} |x[n]|^2$$

When examining energy and power in signals over an infinite time interval, we define the total energy as:

$$E_x \triangleq \lim_{T \rightarrow \infty} \int_{-T}^T |x(t)|^2 dt = \int_{-\infty}^{\infty} |x(t)|^2 dt \quad (\text{in continuous time})$$

$$E_x \triangleq \lim_{N \rightarrow \infty} \sum_{n=-N}^N |x[n]|^2 = \sum_{n=-\infty}^{\infty} |x[n]|^2 \quad (\text{in discrete time})$$

We define the time-averaged power over an infinite interval as:

$$P_x \triangleq \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |x(t)|^2 dt \quad (\text{in continuous time})$$

$$P_x \triangleq \lim_{N \rightarrow \infty} \frac{1}{2N+1} \sum_{n=-N}^N |x[n]|^2 \quad (\text{in discrete time})$$

We identify three classes of signals

1. Signals with finite total energy $E_x < \infty$

Such a signal must have zero average power as $P_x = \lim_{T \rightarrow \infty} \frac{E_x}{2T} = 0$.

Signals And Systems Solution

Steven T. Karris



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distribution theory Drawing on much of the author's own research work this book expands the domains of existence of the most important transforms and thus opens the door to a new world of applications using novel powerful mathematical tools

Linear Algebra in Signals, Systems, and Control Biswa Nath Datta, 1988-01-01 Solution Manual for Linear Systems and Signals Bhagwandas Pannalal Lathi, 1992 **Signals & Systems Demystified** David McMahon, 2006-09-06 The fast and easy way to learn signals and systems Get a working knowledge of signal processing and systems even if you don't have formal training unlimited time or a genius IQ Signals and Systems Demystified offers an effective illuminating and entertaining way to learn this essential electrical engineering subject First you'll learn methods used to calculate energy and power in signals Next you'll study signals in the frequency domain using Fourier analysis Other topics covered include amplitude frequency and phase modulation spectral analysis convolution the Laplace transform and the z transform Packed with hundreds of sample equations and explained solutions and featuring end of chapter quizzes and a final exam this book will teach you the fundamentals of signals and systems in no time at all Simple enough for a beginner but challenging enough for an advanced student Signals and Systems Demystified is your shortcut to mastering this complex subject This hands on self teaching text offers An easy way to understand signal processing and systems Hundreds of worked examples with solutions A quiz at the end of each chapter to reinforce learning and pinpoint weaknesses A final exam at the end of the book No unnecessary technical jargon A time saving approach to performing better on an exam or at work Signals, Systems, and Transforms Leland B. Jackson, 1991-01 **Transforms in Signals and Systems Solutions Manual** Kraniuskas, 1993-12 *Fundamentals of Stochastic Signals, Systems and Estimation Theory with Worked Examples* Branko Kovačević, Željko Đurović, 2008 *Random Signals and Systems* Bernard Picinbono, 1993 A presentation of random signals and systems focusing on applications often encountered in practice It makes use of geometrical methods contains a systematic presentation of covariance matrices and includes a discussion of Gaussian complex random vectors Signals and Systems Steven T. Karris, 2008 Introductory text on Signals Systems and Signal Processing topics with MATLAB computations and modeling with Simulink **Real Time Signal Processing VI** Keith Bromley, 1983 The IEE Irish Signals and Systems Conference 2005, 2005 Presents a major forum for engineers and researchers in Ireland on communications control and DSP This conference is one of the premier conferences held in Ireland addressing a number of aspects

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