Digital Signal Processing

Lecture (8): Standard Discrete-Time Signals

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نظام المحاضرات الالكتروني

The unit ramp signal

The unit ramp signal is denoted as $u_r[n]$ and is defined as

$$u_r[n] = \begin{cases} n & for\ n \geq 0 \\ 0 & for\ n < 0 \end{cases}$$

The graphical representation of unit ramp signal is shown in Figure (3).

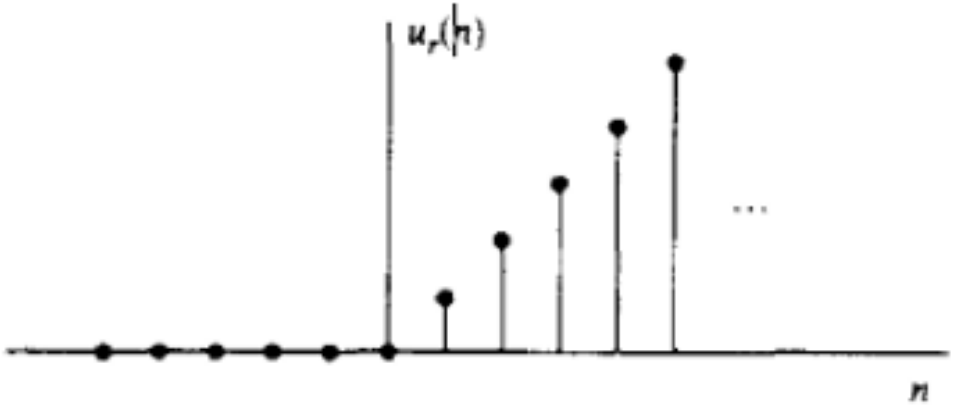


Figure (3): Unit ramp signal

The exponential signal

The exponential signal is a sequence of the form

$$x[n] = a^n \qquad \text{for all n}$$

If the parameter a is real, then $x[n]$ is a real signal. Figure (4) illustrates $x[n]$ for various values of the parameter a.

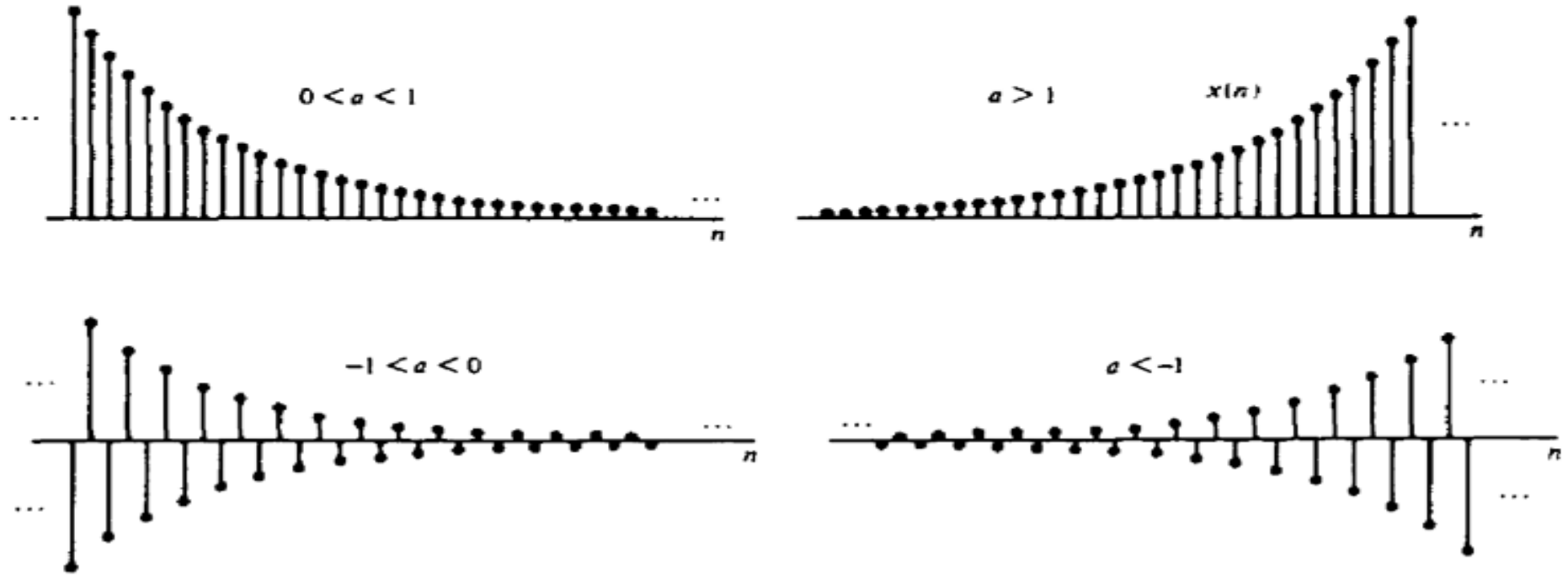


Figure (4): Graphical representation of exponential signals

The exponential signal

When the parameter a is complex valued, it can be expressed as $a = re^{j\theta}$ where r and θ are now the parameters. Hence we can express $x[n]$ as

$$x[n] = r^n e^{j\theta n} = r^n(\cos\theta n + j\, sin\theta n)$$

Since $x[n]$ is now complex valued, it can be represented graphically by plotting the real part

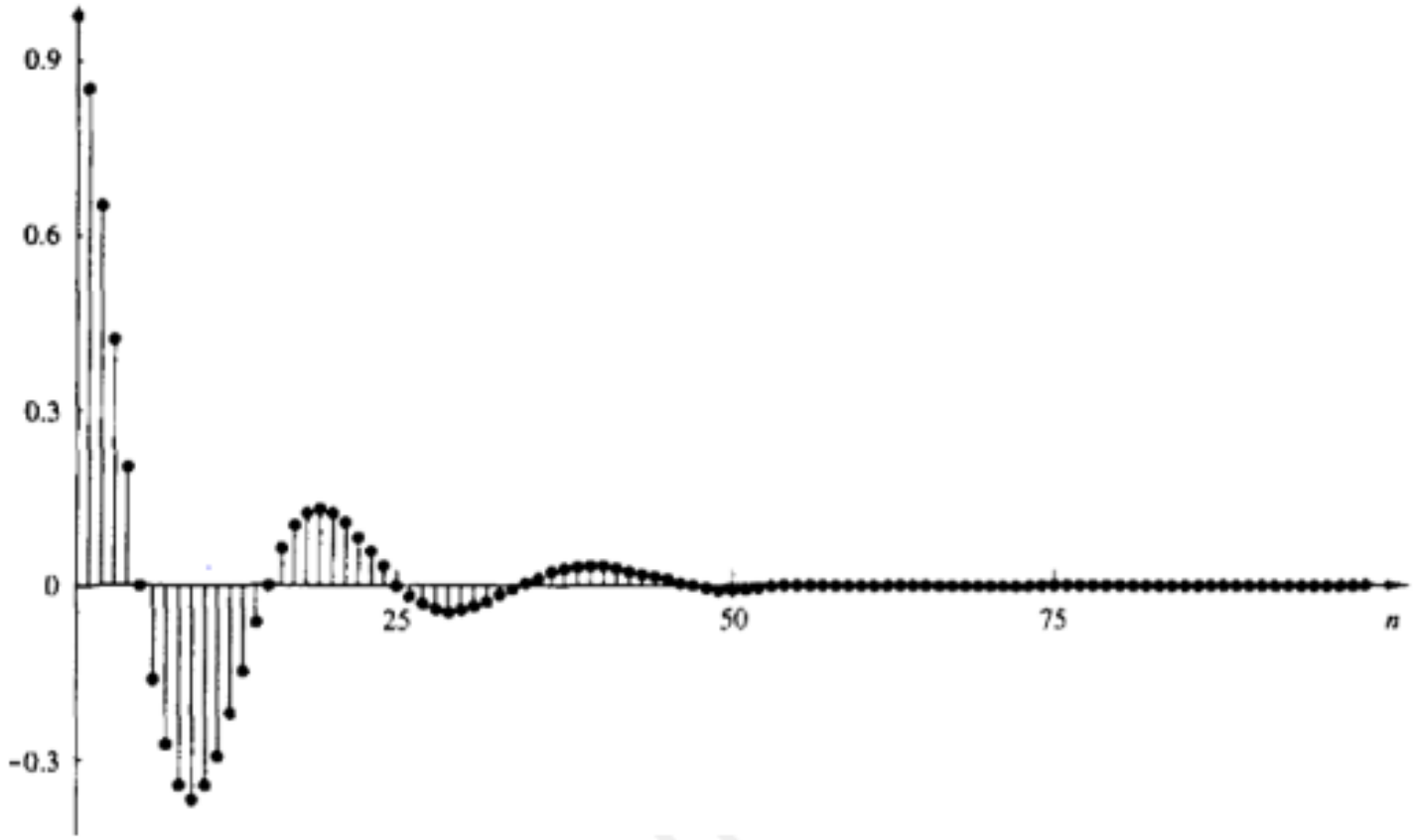
$$x_R[n] = r^n \cos\theta n$$

as a function of n, and separately plotting the imaginary part

$$x_I[n] = r^n \sin\theta n$$

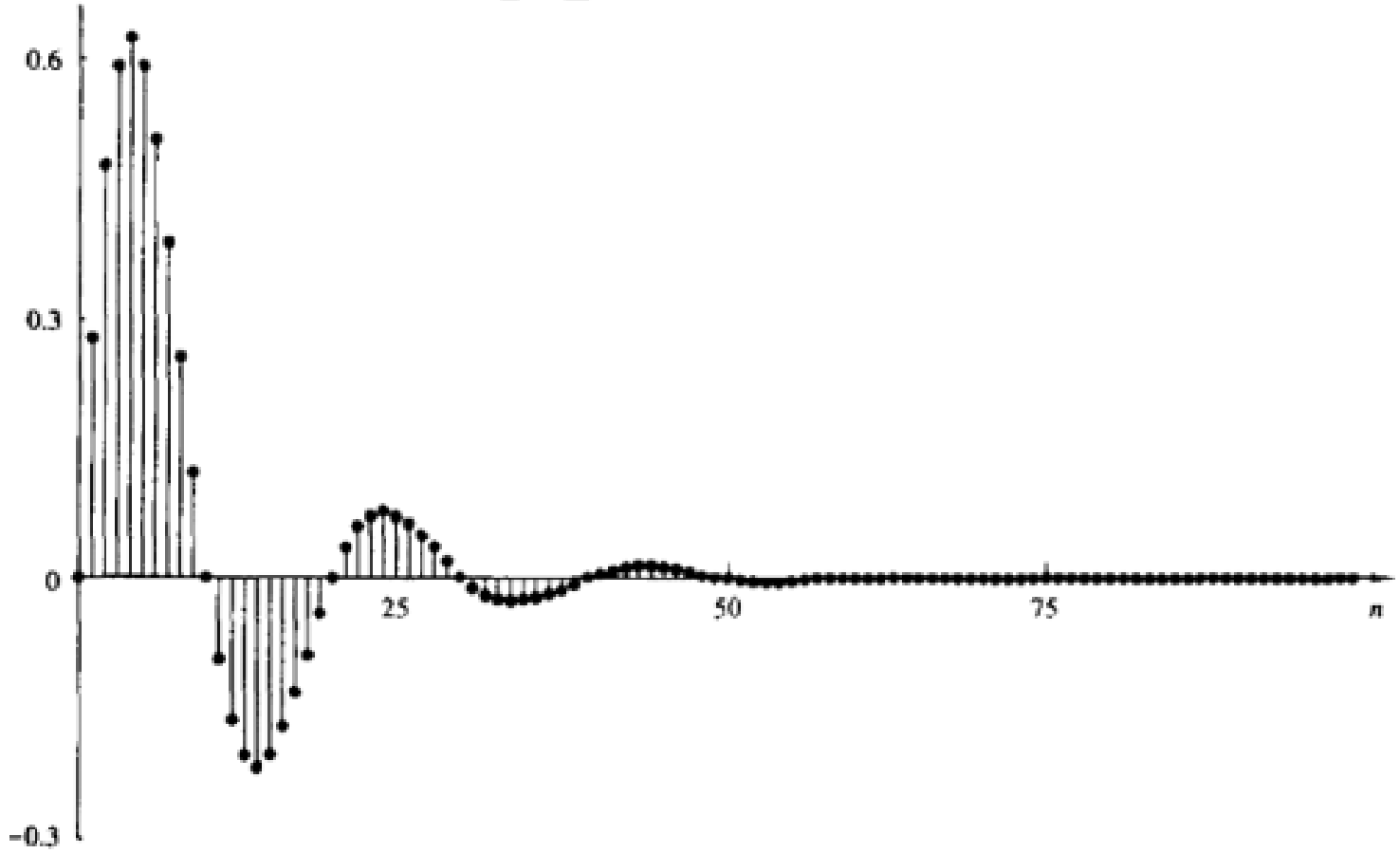
as a function of n. Figure (5) illustrates the graphs of $x_R[n]$ and $x_I[n]$ for $r = 0.9$ and $\theta = \frac{\pi}{10}$.

The exponential signal



Graph of $x_R[n] = (0.9)^n \cos\frac{\pi n}{10}$

The exponential signal



Graph of $x_1[n] = (0.9)^n \sin\frac{\pi n}{10}$