TECHIN 513 HW3

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1

To determine the DTFS coefficients of the periodic signal with period $N = 6$, we use the formula:

$$X[k] = \frac{1}{N} \sum_{n=0}^{N-1} x[n] e^{-j\frac{2\pi}{N}kn}$$

$X[0]$:

$$X[0] = \frac{1}{6} \sum_{n=0}^{3} 1 = \frac{4}{6} = \frac{2}{3}$$

$X[k]$ for $k = 1, 2, 3, 4, 5$:

$$X[k] = \frac{1}{6} \sum_{n=0}^{3} e^{-j\frac{2\pi}{6}kn}$$

$$= \frac{1}{6} \cdot \frac{1 - e^{-j\frac{\pi}{3}k \cdot 4}}{1 - e^{-j\frac{\pi}{3}k}}$$

$$= \frac{1}{6} \cdot e^{-j\frac{\pi}{2}k} \cdot \frac{\sin\left(\frac{2\pi}{3}k\right)}{\sin\left(\frac{\pi}{6}k\right)}$$

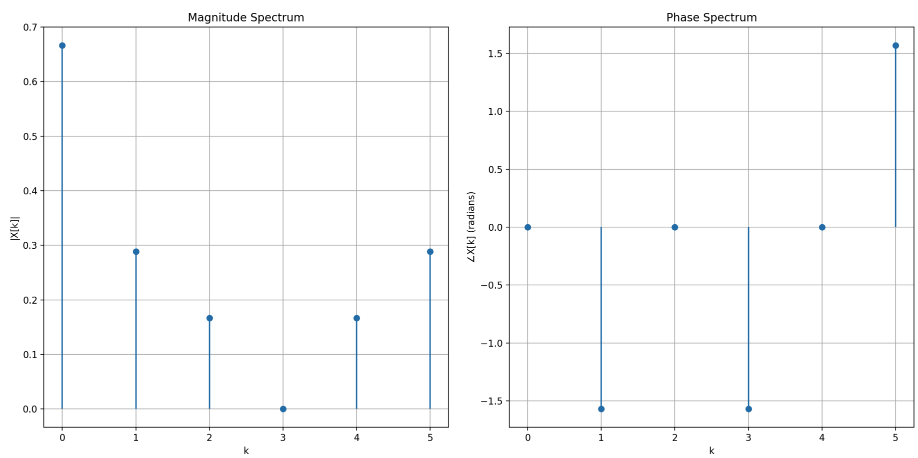

Figure 1: Plot of the DTFS coefficients.

2

To verify the reconstruction of the original signal from its DTFS coefficients, we implemented a Python program. The program computes the inverse DTFS and compares the reconstructed signal with the original signal. The results are visualized using stem plots, showing that the reconstructed signal matches the original signal accurately. This confirms that the Fourier series correctly represents the original signal.

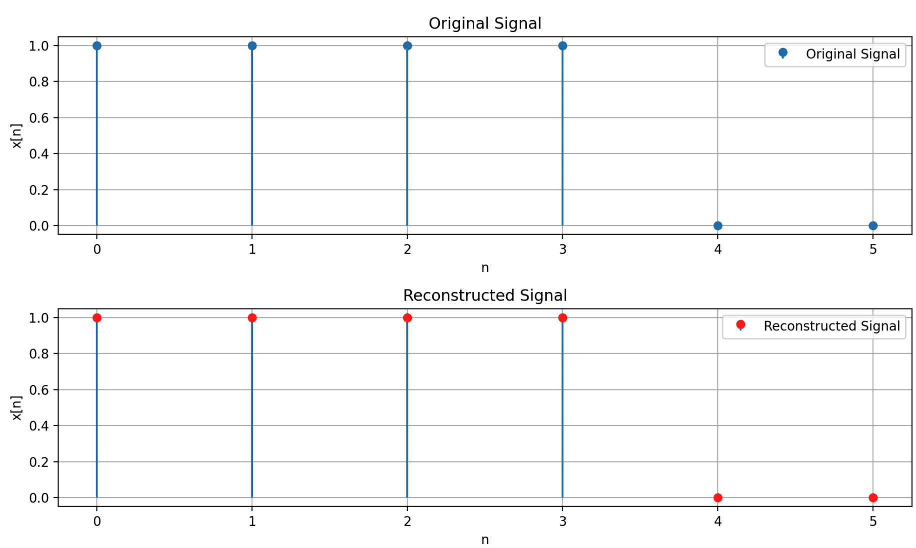

Figure 2: Verification for the Fourier series.