DCT - II

Discrete Cosine Transform:

Discrete-Time Signal Processing

$$\widetilde{X}^{c2}[k] = \sqrt{\frac{2}{N}}\widetilde{\beta}[k]\sum_{n=0}^{N-1} x[n]\cos\left(\frac{\pi k\,(2n+1)}{2N}\right), \qquad k = 0, 1, ..., N-1.$$

where,

$$\widetilde{\beta}[k] = \begin{cases} \frac{1}{\sqrt{2}}, & k = 0, \\ 1, & k = 1, 2, ..., N-1. \end{cases}$$

With scaling factor,

$$\widetilde{X}^{c2}[k] = \omega[k]\sum_{n=0}^{N-1} x[n]\cos\left(\frac{\pi k\,(2n+1)}{2N}\right), \qquad k = 0, 1, ..., N-1.$$

where,

$$\omega[k] = \begin{cases} \frac{1}{\sqrt{N}}, & k = 0, \\ \sqrt{\frac{2}{N}}, & k = 1, 2, ..., N-1. \end{cases}$$

Inverse Discrete Cosine Transform:

$$x[n] = \sqrt{\frac{2}{N}}\sum_{k=0}^{N-1} \widetilde{\beta}[k]\,\widetilde{X^{c2}}\,\cos\left(\frac{\pi k\,(2n+1)}{2N}\right), \qquad 0 \le n \le N-1,$$

where,

$$\widetilde{\beta}[k] = \begin{cases} \frac{1}{\sqrt{2}}, & k = 0, \\ 1, & k = 1, 2, ..., N-1. \end{cases}$$

With scaling factor,

$$x[n] = \sum_{k=0}^{N-1} \omega[k]\, \widetilde{X}^{c2}[k]\, \cos\left(\frac{\pi k\,(2n+1)}{2N}\right), \qquad 0 \le n \le N-1,$$

where,

$$\omega[k] = \begin{cases} \frac{1}{\sqrt{N}}, & k = 0, \\ \sqrt{\frac{2}{N}}, & k = 1, 2, ..., N-1 \end{cases}$$