## Discrete Cosine Transformation

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## 1 Discrete Cosine Transformation:

$$\begin{split} \tilde{X}^{c2}[k] &= \sqrt{\frac{2}{N}} \tilde{\beta}[k] \sum_{n=0}^{N-1} x[n] \cos \left( \frac{\pi k \left( 2n+1 \right)}{2N} \right), \qquad k=0,1,...,N-1. \\ \text{where, } [\mathbf{k}] &= \begin{cases} \frac{1}{\sqrt{2}}, & k=0,\\ 1, & k=1,2,...,N-1. \end{cases} \end{split}$$

With scaling factor,

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

where

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

## 2 Inverse Discrete Cosine Transform:

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

where,

$$[k] = egin{cases} rac{1}{\sqrt{2}}, & k = 0, \\ 1, & k = 1, 2, ..., N - 1. \end{cases}$$

With scaling factor,

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

where,  

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