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UC Berkeley EECS

Maharbiz and Roychowdhury

Lecture 13A

Signals

Discrete Fourier Transform (DFT)

Audio DSP: powered by the DFT

JPEG images: powered by DCTs

JPEG quality: 98

JPEG quality: 5 (higher spatial frequencies discarded)

8x8 DCT blocks

DCT vs DFT

DCT-II [edit]

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

The DCT-II is probably the most commonly used form, and is often simply referred to as "the DCT".[1][2]

This transform is exactly equivalent (up to an overall scale factor of 2) to a DFT of $4N$ real inputs of even symmetry where the even-indexed elements are zero. That is, it is half of the DFT of the $4N$ inputs y_n, where $y_{2n} = 0$, $y_{2n+1} = x_n$ for $0 \le n < N$, $y_{2N} = 0$, and $y_{4N-n} = y_n$ for $0 < n < 2N$. DCT II transformation is also possible using 2N signal followed by a multiplication by half shift. This is demonstrated by Makhoul.