TASK 4

Radix-2 FFT

TASK 1

Radix-2 in FFT:

The radix-2 FFT algorithms are used for data vectors of lengths N = 2K. They proceed by dividing the DFT into two DFTs of length N/2 each, and iterating. There are several types of radix- 2 FFT algorithms, the most common being the decimation-in-time (DIT) and the decimation-in-frequency (DIF).

TASK 2

Difference between Decimation-in-time (DIT) and Decimation-in-frequency (DIF)

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| --- | --- |
| Decimation-in-time (DIT) | Decimation-in-frequency(DIF) |
| A N-point signal x[n] of even length.  The derivation of the DIT radix-2 FFT begins by splitting the sum into two parts —  One part for the even-indexed values x[2n] and one part for the odd-indexed values x[2n + 1].  Define two N/2-point signals x1[n] and x2[n] as x0[n] = x[2n] x1[n] = x[2n + 1] for 0 ≤ n ≤ N/2 – 1 | A N-point signal x[n] of even length.  The derivation of the DIF radix-2 FFT begins by splitting the DFT coefficients X[k] in to  even- and odd- indexed values. The even values X[2k] are given by:  X[2k] = N X−1 n=0 x[n] W−2kn N = N X−1 n=0 x[n] W−kn N/2 . |

TASK 3

Bit reversal:

A bit reversal  is a permutation of sequence of *n* items, where *n* = 2*k* is a power of two . It is defined by indexing the elements of the sequence by the numbers from 0 to *n* − 1 and then reversing the binary representations of each of these numbers .Each item is then mapped to the new position given by this reversed value.

Need of bit reversal:

When implementing the fft, we always include a bit reverse at the end of the process to put the data in the correct order. It seems to be because the fft proceeds by decimating the input array into odd/even sections (for radix-2 algorithms, for other algorithms e.g. prime factor you have to do a radix reverse), the final stage of the algorithm involves multiplications (by several exponential factors) on the individual array members.

TASK 4

Implementation on DSP:

The implementation is done in DSP by considering the real and imaginary values of input samples with a function.



