Experiment No: 10 Date: 14/10/2024

LINEAR CONVOLUTION
USING DSP PROCESSOR

Aim

To perform Linear Convolution of two sequences using DSP Processor.

Theory

A **DSP (Digital Signal Processor)** is a specialized microprocessor designed specifically for the efficient processing of signals in digital form. It is commonly used in applications that involve real-time processing of audio, video, communications, radar, and other sensor data. DSPs excel at executing mathematical algorithms that involve large amounts of data in parallel, which is essential for tasks like filtering, Fourier transforms, compression, and more.

Key Characteristics of a DSP Processor:

1. **Optimized for Signal Processing**: DSPs are designed to handle mathematical operations like addition, subtraction, multiplication, and division, which are frequent in signal processing tasks.
2. **Parallel Processing**: Many DSP processors support parallel processing or Single Instruction Multiple Data (SIMD) operations, enabling them to process multiple data streams simultaneously.
3. **High Throughput**: DSPs often have dedicated hardware for tasks like multiplying and accumulating (MAC), which helps them handle high-volume data streams efficiently.
4. **Low Latency**: DSPs are designed to handle real-time processing with minimal delay, making them ideal for applications like audio and video encoding/decoding, telecommunications, and control systems.
5. **Fixed-Point and Floating-Point Arithmetic**: DSPs often support both fixed-point and floating-point arithmetic, with fixed-point being more common for resource-constrained applications where precision requirements are lower.
6. **Specialized Instructions**: DSPs often come with specialized instructions that accelerate specific signal processing operations, such as fast Fourier transforms (FFT) and filtering.
7. **Power Efficiency**: Because many DSP tasks involve repetitive, predictable operations, DSPs are designed to be power-efficient compared to general-purpose CPUs for these tasks.

Examples of DSP Processors:

Texas Instruments (TI) DSPs: These processors are widely used in industrial, automotive, and telecommunications applications. Popular models include the C2000 and TMS320 series.

Procedure

- Open Code Composer studio
  Click on file → New → CCS Project
  Select the Target → C674 Floating point DSP
  TMS320C6748
  Connection → Texas Instruments x DS 100V2 USB Debug Probe
  And verify
  Give the project name and select finish.

- Type the code program for generating the sine wave and choose File → Save As and then save the program with a name including "main.c" .Delete the already existing main.c program.

- Select the debug option from the Run Menu.

- In the Debug perspective ,click Resume to run the code on DSP
- Observe the console output to verify the Convolution result.

Program

```
# include <stdio.h>
  int y[7];
#include<math.h>
#define pi 3.1415625
 float a[200];
 void main(){
        int i,j;
        int m=4;
        int n=4;
        int x[7]={1,2,3,4}
        int h[7]={4,3,2,1}
        for (i=0 ,i<m+n-1;i++){
            y[i]=0;
            for (j=0 ,j<=i,j++){
                    y[i]+=x[j]*h[i-j];
                }
            }
        printf("Linear Convolution output \n");
        for (i=0 ,i<m+n-1;i++){
                printf("%d \n",y[i]);
            }
      }
```

Result

Performed the Linear Convolution of two sequences using DSP processor.

OBSERVATION

Linear Convolution output

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11

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20

11

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