

A Parallel Application of the Fourier Transformation

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Abstract

A Fourier transform is a mathematical transform decomposing functions based on space and time into functions based on spatial or temporal frequency. The Fourier transform is denoted by adding a circumflex to the symbol of a function:

$$f \rightarrow \hat{f}$$

The Fourier transform is defined as:

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx \quad (1)$$

Whereas the inverse Fourier transform is denoted as:

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi) e^{2\pi i x \xi} d\xi \quad (2)$$

Introduction

The Fourier Transform is an important mathematical concept. It has applications in digital signal processing, convolution in neural networks, image recognition and even speech processing. The main idea behind the Fourier Transform is that it is a "mathematical operation that changes the domain (x-axis) of a signal from time to frequency," [Maklin(2019)].

Parallelization

There are a few different directions to explore when developing a more parallelized implementation of the Fourier Transform. Two methods of Parallelization that stand out in particular are SIMD, and multithreading.

This is a test citation. [Knuth(1984)] This is a test citation. [Liu(N/A)]

SIMD

Multithreading

References

[Maklin(2019)] Cory Maklin. Fast fourier transform, 2019. URL <https://towardsdatascience.com/fast-fourier-transform-937926e591cb>.

[Knuth(1984)] Donald E. Knuth. Literate programming. *The Computer Journal*, 27(2):97–111, 1984.

[Liu(N/A)] Bo Liu. Parallel fast fourier transform, N/A. URL <https://cs.wmich.edu/gupta/teaching/cs5260/5260Sp15web/studentProjects/tibah>