Initial Project Report

Fractional Fourier Transformation(FrFT) and Watermarking in FrFT

Outline :

With the knowledge we have we are able to study a signal in time domain and by transforming it into frequency domain using Fourier transform, we can analyze a signal in frequency domain also. But in real-life we come across many signals which vary in both time and frequency simultaneously. So, we want to have a representation where we can study the signal in time and frequency domains at a time.

Time-frequency analysis allow us to do this. There are many popular representations where we can analyze a signal in both time and frequency domains. One of them is Short-time Fourier Transform. We compute this by dividing the time domain signal into equal segments and compute Fourier transform of each segment and plot it as a function of time.

Even though there are many time-frequency representations, Fractional Fourier transform (FrFT) has its own way. Here we can think of it as generalization of Fourier Transform. The FrFT depends on a parameter α and can be interpreted as the rotation in time-frequency plane by an angle α. We represent FrFT as X_α (u). If α is 0, then it is time domain signal x(t). If $\alpha = \pi/2$, then it is Fourier Transform.

In this project, we will introduce the FrFT and its properties. Later relation between general time-frequency representation which is Short-time Fourier transform and Fractional Fourier transform.

There are many applications which are dependent on Frft. Some of the applications of frft are Filtering and Noise Removal ,Representing Optical Components .We are hoping that there will be more and more applications in future. Watermarking in fractional Fourier domain is one of the important applications

Digital Watermarking is a process of hiding digital information. This is widely used to verify the authenticity. Frequently used in marking important documents like passports, or envelopes and stamps. In this context FrFT is useful to embed the watermark with the carrier signal.

What we are planning to do...

- We want to start with the Time-Frequency analysis and its representations. In this context we want to have a look at short- time Fourier Transform.
- We want to go through the detailed Fractional Fourier transform and its properties.
- We are planning to do MATLAB code to get exact visualization of Fractional Fourier transform.
- We saw some of the applications in Fractional Fourier domain. We found that watermarking is best and currently useful.
- We collected some information and uses of watermarking and we will go through the watermarking in Fractional Fourier domain.

References

1 https://sci-hub.do/https://www.sciencedirect.com/science /article/abs/pii/S1084804500901280

I. Djurović, S. Stanković, and I. Pitas, “Digital watermarking in the fractional Fourier transformation domain,” Journal of Network and Computer Applications, vol. 24, no.2,pp.167-173,Apr.2001.

2 https://sci-hub.do/https://ieeexplore.ieee.org/document/330368

L. B. Almeida 1994. The fractional Fourier transform and time-frequency representations. IEEE

Trans. Sig. Proc., 42(11), 3084–3091.

3 https://sci-hub.do/https://www.sciencedirect.com/science/article/abs/pii/S0165168410003956

Fractional Fourier transform as a **signal processing** tool: An overview of recent developments