AMRITA VISHWA VIDYAPEETHAM

19ECE-284 DIGITAL SIGNAL PROCESSING LAB

PROJECT TITLE PROPOSAL

AMRITA VISHWA VIDYAPEETHAM School Of Engineering

SIGNAL PROCESSING WITH COMPRESSED SENSING

AND

OPTIMIZED FOURIER TRANSFORM

TEAM NUMBER: 3

Team Members

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Motivation:

One of the major constraints in signal compression and transmission rate is the Nyquist rate. This gives us the minimum amount of data required to reconstruct the original signal accurately. This motivated us to look at new algorithms and techniques to overcome these limitations. We found the concept of compressed sensing and decided to implement this to demonstrate its properties and reduce its computations by using optimized Fourier transform algorithms.

Problem statement:

Implement a system which could reconstruct a signal which has been sampled at a rate lesser than Nyquist rate and evaluate and discuss about its performance and viability.

Objectives:

1. Obtain algorithms for compressed sensing.
2. Obtain fourier transform optimization algorithms.
3. Transmission of under sampled signal and subsequent reception and reconstruction of the signal
4. Evaluating the performance of this new algorithm.

Abstract:

This project proposal outlines the investigation of compressed sensing (CS) and optimized Fourier Transform (FT) algorithms for signal reconstruction at sub-Nyquist sampling rates. The project aims to explore the potential of CS in overcoming limitations imposed by the Nyquist rate and evaluate its performance through various metrics. Additionally, by incorporating optimized FT algorithms, the project seeks to reduce computational complexity associated with signal processing tasks.

The proposed methodology involves a comprehensive literature review to identify suitable CS and FT algorithms, followed by performance evaluation and potential algorithm modifications. The project deliverables include a list of evaluated algorithms, their performance metrics, and potentially an improved or novel algorithm for CS and FT optimization.

Tools required:

1.Python

2.Matlab

Methodology:

1. Conduct a thorough literature review on existing research on compressed sensing (CS) techniques, optimized algorithms for Fourier Transforms and their applications in signal processing.
2. Identify relevant algorithms, performance metrics, and performance challenges.
3. Select appropriate CS algorithm and Fourier Transforms algorithms considering reconstruction accuracy, complexity and proper combinations of algorithms in both fields.
4. Capture a signal, sample lower than the Nyquist rate, use an optimized FFT algorithm, then transmit the signal, receive it, filter it, reconstruct the original signal.
5. Evaluate the performance of the system using standard metrics.
6. Try modifications in available algorithms or code and compare results.

Timeline:

Time Line	Work
Week 1	Literature review on all algorithms
Week 2	Identifying relevant algorithms, performance metrics
Week 3	Evaluating 30% of the listed algorithms.
Mid – Term	
Week 4-5	Evaluating the rest of the algorithms
Week 6	Preparing the best combination and preparation of full system
Week 7-8	Documentation and presentation of the results
END-SEMESTER	

Deliverables:

1. Different Algorithms for Compressed Sensing and optimizing fourier transform will be listed.
2. Performance metrics for each combination would be found.
3. We hope to create an new or improved algorithm for these processes.

Conclusion:

By successfully implementing this project, we expect to gain valuable insights into the capabilities of CS for signal reconstruction under limited sampling conditions. Furthermore, exploring optimized FT algorithms will contribute to reducing computational demands in signal processing applications. The project findings hold the potential to contribute to advancements in areas requiring efficient signal compression and transmission, particularly in resource-constrained scenarios.

Reference:

1. https://www.sciencedirect.com/topics/computer-science/compressed-sensing
2. https://www.cs.jhu.edu/~misha/ReadingSeminar/Papers/Baraniuk06.pdf
3. https://mecha-mind.medium.com/fast-fourier-transform-optimizations-5c1fd108a8ed
4. https://www.youtube.com/watch?v=SbU1pahbbkc