MA635P-Scientific Programming Laboratory

Trigonometric Polynomial Interpolation:

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Deadline: March 16, 2025

भारतीय प्रौद्योगिकी संस्थान तिरुपति
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Trigonometric Polynomial Interpolation:

Title of the Project

Trigonometric Polynomial Interpolation: Applications in Function Approximation and Signal Processing

Background

- Trigonometric polynomial interpolation is a powerful technique for approximating periodic functions using a sum of sine and cosine terms.
- Function approximation (better than standard polynomial interpolation for periodic functions).
- Machine learning (efficient feature representation for periodic data).

Objective

- Implement trigonometric interpolation for given periodic functions.
- Compare with standard polynomial interpolation (e.g., Lagrange interpolation).
- Analyze error and convergence properties of trigonometric polynomials.
- Apply the method to real-world problems, such as:
  1. Function approximation (e.g., interpolating $\sin(x), e^x$, or noisy signals).
  2. Fourier-based signal processing (e.g., denoising and compression).
  3. Machine learning feature extraction (e.g., representing cyclic patterns).

Requirements

Read the following papers/Lecture Notes:

1. EXTENSION OF CHEBFUN TO PERIODIC FUNCTIONS
2. Trigonometric Polynomial Approximation

Steps to Solve

1. Generate Sample Data
   - 1.1 Use synthetic functions (e.g., $f(x) = \sin(x) + \cos(2x)$).
   - 1.2 Use real-world signals (e.g., ECG data, stock market trends).
2. Compute Trigonometric Interpolation
   - 2.1 Implement DFT-based coefficient computation.
   - 2.2 Use FFT (Fast Fourier Transform) for efficient computation.
3. Compare with Polynomial Interpolation
   - 3.1 Apply Lagrange and Chebyshev interpolation and compare errors.
   - 3.2 Demonstrate how trigonometric interpolation avoids Runge's phenomenon.

Deliverable

1. A Python-code for
2. A report on error analysis, comparison with polynomial interpolation and Runge's phenomenon
3. Identify a problem that has the applications

Team

Team

- MA23M004 BADAL KUMAR
- MA23M012 SARVJEET KUMAR SINGH
- MA23M020 ABHISHEK KUMAR YADAV
- MA23M016 AARTI JANGIR

Thanks

Doubts and Suggestions

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