INTRODUCTION TO MATHEMATICAL SIGNAL PROCESSING: FOURIER ANALYSIS

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The aim of this series of lectures is to show how mathematics is involved in our daily life by introducing mathematical theories of signal processing. Fourier analysis has played a fundamental and crucial role in development of the signal processing. We glance through examples of practical applications in the area, especially in audio/image processing, and see how Fourier analysis comes into play. We cover various topics which benefit from Fourier analysis, such as basis/frame theory, Shannon's sampling theorem, wavelets etc. Both theoretical and practical aspect of the topics are to be discussed.

Basic linear algebra and analysis is prerequisite for the lectures. The lectures are intended for auditors attending all, however auditors interested in a particular topic according to the schedule below are also welcome to attend just that lecture.

Schedule

- Lecture 1
  - a brief overview of mathematical signal processing with various examples
- Lecture 2
  - Fourier transform, Fourier harmonics as an orthogonal basis of certain Hilbert spaces
- Lecture 3
  - bases/frame theory, Shannon's sampling theorem
- Lecture 4
  - wavelets, applications based on multi-resolution analysis

References

- Prof. H. Feichtinger's lecture note on computational harmonic analysis (http://www.nuhag.eu).
- C. Heil, A basis theory primer, Expanded, Birkhäuser/Springer, New York, 2011.
- J.R. Higgins, Sampling theory in Fourier and signal analysis, Oxford University Press, USA, 1996.

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