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# An Overview on Harmonic Analysis and Its Branches

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## Editorial

Harmonic analysis is a discipline of mathematics that studies and generalizes the concepts of Fourier series and Fourier transforms, as well as the representation of functions or signals as the superposition of fundamental waves. It has evolved into a huge field with applications in number theory, representation theory, signal processing, quantum physics, tidal analysis, and neurology during the last two centuries. The name "harmonics" comes from the Ancient Greek word harmonikos, which means "musical ability." It was originally used in physical eigenvalue issues to refer to waves whose frequencies are integer multiples of one another, similar to the frequencies of music notes' harmonics, but the phrase have now been expanded beyond its original definition [1,2].

The classical Fourier transform on Rn is still a work in progress, especially when it comes to Fourier transformation on more generic objects like tempered distributions. For example, if we set some constraints on a distribution f, we can try to express these constraints using the Fourier transform of "f." One example is the Paley–Wiener theorem. If f is a nonzero distribution of compact support, then its Fourier transform is never compactly supported, according to the Paley–Wiener theorem. In a harmonic-analysis situation, this is a very basic form of an uncertainty principle. Fourier series may be examined more easily in the setting of Hilbert spaces, which connects harmonic analysis with functional analysis [3].

The Digital Fourier Transform: discrete/periodic-discrete/periodic; The Fourier Analysis: continuous/periodic-discrete/aperiodic; The Fourier Synthesis: discrete/aperiodic-continuous/periodic; and The continuous Fourier Transform: continuous/aperiodic-continuous/aperiodic; and The continuous Fourier Transform: continuous/aperiodic-continuous/aperiodic Analysis on topological groups is one of the more recent fields of harmonic analysis, with origins in the mid-twentieth century. The different Fourier transforms, which may be applied to a transform of functions defined on Hausdorff locally compact topological groups, are the core driving notions. Pontryagin duality is a theory for abelian locally compact groups. Harmonic analysis investigates the aspects of that duality and Fourier transform, attempting to generalize those qualities to other situations, such as non-abelian Lie groups [4].

Harmonic analysis is strongly connected to the idea of unitary group representations for generic non-abelian locally compact groups. The Peter–Weyl theorem for compact groups shows how one may get harmonics by selecting one irreducible representation from each equivalence class of representations. In terms of carrying convolutions to point wise products or generally demonstrating a certain comprehension of the underlying group structure, this choice of harmonics has some of the same desirable qualities as the conventional Fourier transform [5].

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