INTEGRAL TRANSFORMS AND REPRODUCING KERNELS

Organizers:

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Aims: Over the years, motivated by applications in initial and boundary value ordinary and partial differential equations, many integral transforms have been constructed, leading to rich mathematical theories with an outstanding effectiveness in physical and signal analytic applications. A notorious famous example is the use of the Fourier transform in heat conduction problems and signal analysis of band-limited functions.

Today, a number of transforms have reached a classical status, namely those associated with the names of Laplace, Fourier, Mellin, Hankel, Radon and Hilbert. They are all widely used in physics and signal analysis. More recently, many fractional integral transforms became popular in image reconstruction, pattern recognition and acoustic signal processing. A notable class of integral transforms, developed with the goal of understanding non-stationary phenomena in several geometries is provided by the so-called coherent states transforms CST (including Gabor and wavelet transforms, by specifying the underlying geometries to euclidean and hyperbolic and the groups structure to the Heisenberg and affine cases). They have been used in Schroedinger equations with specific potential, in the analysis of higher Landau level eigenspaces, in the analysis of nonstationary signals, in analytic and polyanalytic function theory, in frame theory and, more recently, in determinantal point processes (for instance, in Ginibre-type models for higher Landau levels and in the so-called Weyl-Heisenberg ensemble). On the background of all these applications is the fact that the range of CST is a reproducing kernel Hilbert space. Another useful transform defined via reproducing kernels is the Berezin transform, which shows up naturally in quantization-dequantization procedures. Our aim in this session is to discuss old and new integral transforms: their origin, their mathematical properties (in particular, of their reproducing kernel structure) and their potential use to solve problems in mathematics, signal analysis and physics.