SEMINAR NOTICE

Department of Physics and Engineering Physics
University of Saskatchewan

SPEAKER: Dr. Artur Sowa
Department of Math & Stats

TOPIC: ***New Application of Harmonic Analysis to Quantum Theory and Engineering***

DATE: Tuesday January 25th, 2022

TIME: 3:30-4:30 p.m.

PLACE: ***Webex***

Webex: https://usask-beta.webex.com/usask-beta/j.php?MTID=m91e8154d69bd90874627143d499f0ea7

ABSTRACT:

Harmonic analysis has played a foundational role in quantum theory all throughout its historical development. To recall a few well-known examples, it is expressly present in the Heisenberg uncertainty principle (1920s); it was fundamental in solving the quantum spin chain (1970s); it now helps to gain insights into the problem of quantumness in relation to quantum computing (2010s). While sourcing some of its methods from the repertoire of harmonic analysis, Physics has always generously paid back, e.g., the coherent state theory stimulated the development of wavelet techniques and of the linear canonical transform. In this talk I will highlight some lesser-known recent examples of quantum applications of harmonic analysis. In particular, I will demonstrate how the Haar transform (i.e., a special type of wavelet transform) helps to analyze the dynamics of an array of qubits. I will also highlight applications of the generalized Fourier transform on the multiplicative group of positive rationals (i.e., the group furnished by the multiplication of common fractions) to the analysis of arrays of bosons. The ultimate purpose of this work is to help countervail the so-called "curse of dimensionality" which arises in quantum engineering and other aspects of quantum theory and modelling. The outcomes that I will relay serve as good examples of value being added (and multiplied) when mathematicians and physicists exchange ideas. The tools that were inspired by these collaborative efforts help tackle more general problems of operator analysis. They also highlight some mesmerizing new connections between quantum theory and the analytic number theory as well as fractals.