Department of Mathematics, BGU

Colloquium

On *Tuesday, December ,28 2021*

At *14:30 – 15:30*

In *Math 101-*

Ron Levie (LMU)

will talk about

Wavelet-Plancherel: a new theory for analyzing and processing wavelet-based methods

Abstract: Continuous wavelet transforms are mappings that isometrically embed a signal space to a coefficient space over a locally compact group, based on so-called square integrable representations. For example, the 1D wavelet transform maps time signals to functions over the time-scale plane based on the affine group. When using wavelet transforms for signal processing, it is often useful to work interchangeably with the signal and the coefficient spaces. For example, we would like to know what operation in the signal domain is equivalent to multiplication in the coefficient space. While such a point of view is natural in classical Fourier analysis (i.e., "time convolution is equivalent to frequency multiplication"), it is not compatible with wavelet analysis, since wavelet transforms are not surjective. In this talk, I will present the wavelet-Plancherel theory – an extension of classical wavelet theory in which the wavelet transform is canonically extended to an isometric isomorphism. The new theory allows

formulating a variety of coefficient domain operations as signal domain operations, with closed form formulas. Using these so-called pull-back formulas, we are able to reduce the computational complexity of some wavelet-based signal processing methods. The theory is also useful for proving theorems in wavelet analysis. I will present an extension of the Heisenberg uncertainty principle to wavelet transforms and prove the existence of uncertainty minimizers using the wavelet-Plancherel theory.