APPLICATIONS OF HARMONIC ANALYSIS TO SEISMIC IMAGING

Mathematical modelling of the propagation of waves is key to understanding a wide range of physical phenomena. Techniques from harmonic analysis, including theoretical and numerical implementations of pseudo differential operators, Fourier integral operators, and time-frequency decompositions are some of the methods our geo-mathematics research group has been developing to improve the modeling of seismic waves propagating in the earth.

We describe the methodology of Gabor transforms and Gabor multipliers, which are fast and accurate numerical methods to analyze non-stationary signals. They also approximate pseudo-differential operators that arise in numerical simulations of wave propagation and certain imaging operators for inverse problems. The Gabor transform is particularly valuable for the analysis of seismic initiators, including explosive and Vibroseis sources. Gabor multipliers allow the modeling of physically realistic minimum phase sources and their propagation through attenuating media.

Dr. Michael Lamoureux is Professor and Head of the Department of Mathematics and Statistics at the University of Calgary. His expertise is in functional analysis and its applications to imaging and inverse problems, in particular in seismic exploration. He leads the geo-mathematics research group at the University of Calgary, which collaborates with mathematicians, geophysicists and engineers on a range of numerical modelling and imaging challenges.