Seismic signal processing: theory and practice from acquisition to imaging and inversion

Kemal Özdemir, Evren Yarman
Schlumberger Gould Research, Department of Geophysics, Cambridge, UK

Abstract

In this workshop the theory and practice of seismic data processing in the industry is reviewed. Starting with the wave equation, an overview for the acquisition systems, different sensors that are being used (pressure sensors and particle motions), the geometries are given. Considering that the data is sampled discretely, we will discuss the subsequent processing of representation, interpolation, regularization, deghosting as well as imaging and inversion problems. Every processing stage of seismic data can be treated as an inverse problem. Each of them requires definition of a forward model and corresponding inverse to achieve a certain objective. Some optimization methods are presented like the fixed point methods, namely greedy/matching pursuit, basis pursuit and variational method for solving the inverse problems, used in which are used frequently in seismic data acquisition and representation. In addition to optimization methods , we will show how techniques from random sampling, Fourier analysis, geometric optics and approximation theory are used to tackle the problems at different stages of seismic data processing.

May 25-26, 2016
Institute of Applied Mathematics
Place: S-210

May 25, 2016

9.30-11.00: Overview of seismic data acquisition and processing

1. Marine and land acquisition geometry and systems
2. Wave equation and sampling theory

Coffee break: 11.00-11.15

11.15-12.30: Measurement and data processing

1. Measurement sensors
2. Signal extraction, noise attenuation, interpolation and deghosting problems
3. Sensors placement for acquisition system design

12.30-14.00: Lunch

14.00-16.00: Numerical methods

1. Least square inversion
2. Sparsity promoting least square inversion

May 26, 2016

9.30-11.00: Imaging and inversion problem

1. Forward model for data
2. Wave propagation
   (a) Asymptotic analysis & eikonal equation
   (b) Numerical solutions

Coffee break: 11.00-11.15

11.15-13.00 : Inverse problem

1. Imaging: The linearized inversion and migration methods
2. Generalized Radon transform, illumination analysis and survey design
3. Full waveform inversion