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DISSERTATION TITLE:	*Dictionary Learning and Sparse Representations for Denoising and Reconstruction of Marine Seismic Data*

Denne avhandlingen foreslår dimensjonsreduksjonsbaserte metoder for å håndtere problemer relatert til støyfjerning og interpolering av seismiske data. De høy-dimensjonale seismiske dataene blir utrykt med et sterkt redusert antall variabler som er relevante for å forstå og reprodusere de fysiske fenomene som genererer de registrerte signalene. Det reduserte utrykket benyttes som basis for å fjerne både tilfeldig og koherent støy og for å interpolere de seismiske signalene over et tettere samplet rutenett.

Marine seismic surveys aim to characterize the geology beneath the sea bottom in order to find or monitor oil and gas reservoirs. During a survey, the vessel sails above the area of interest and emits seismic signals. Each signal is a wavefield that travels down through the water and into the subsurface formations. At each interface between different types of rocks, a portion of the wavefield is reflected toward the sea surface. There, the reflected wavefield is recorded using sensors towed by the vessel. A processing sequence is then applied to the data to transform the recorded wavefield into an interpretable image of the subsurface.

During the acquisition of the seismic data, the reflected wavefield is recorded with a spatial sampling that is too coarse to satisfy the requirements of several processing and imaging steps. In addition, undesired signals, referred to as noise, are recorded together with the seismic wavefield. The noise and the coarse spatial sampling reduces the resolution of the final image if not corrected at an early stage of the seismic processing sequence.

This thesis proposes to remove the noise and to interpolate the seismic wavefield over a dense sampling grid based on dimensionality reduction. The high-dimensional seismic data is expressed using a relatively small number of variables that are relevant to determine and reproduce the physical phenomena that generate the recorded signals. This is achieved by automatically learning a dictionary containing the elementary waveforms embedded in the recordings and by representing the data as sparse linear combinations of these waveforms. This representation is then exploited to identify and remove noises from the data and to interpolate the seismic wavefield over a desired sampling grid.