# Chapter 1

# Conclusions

The main result of this work is a collection of practically affordable numerical methods for seismic data regularization. The efficiency is assured by formulating the problem in an iterative optimization framework and by using efficient convolution-type operators.

In Chapter **??**, I have considered two alternative formulations of the data regularization problem. Both formulations arise from the statistical estimation theory and involve two operators: the forward modeling operator and the regularization operator. One of the formulation, namely the model preconditioning approach, appears to provide faster iterative conversion in most of the practical situations of data regularization. In Chapter **??**, I have introduced the method of recursive filter preconditioning and demonstrated its performance on several synthetic and real data examples.

In Chapter **??**, I have discussed the general theory of forward interpolation and several practical choices for the forward modeling operator in data regularization. B-spline forward interpolation is identified as a particularly convenient choice.

In Chapter **??**, I have studied three possible choices for the regularization operator: tension splines, local plane-wave destruction, and offset continuation. Each of the strategies is appropriate for a particular kind of the regularized data. Plane-wave destructor filters are appropriate for characterizing local continuous events in seismic data. They exhibit an excellent practical performance on real and synthetic test cases. Offset continuation models the regularity of multi-coverage seismic reflection data in the offset direction. As shown in Chapter **??**, the theory of offset continuation is directly connected with the theory of dip moveout. It employs a special partial differential equation to describe the prestack data transformation as a continuous process. In practice, offset continuation takes the form of a local convolution operator directly applicable for data regularization. Its performance is exemplified with synthetic and real data tests.

In summary, the main contributions of my work have been:

1. Preconditioning by recursive filtering as a general method for accelerating the convergence of iterative data regularization.
2. A general approach to iterative data regularization using B-spline forward interpolation.
3. New choices for the regularization filters:
   (a) tension-spline filters for regularizing smooth two-dimensional surfaces,
   (b) local plane-wave-destructor filters for regularizing seismic images,
   (c) offset and shot continuation filters for regularizing prestack seismic data.
4. A comprehensive theory of differential offset continuation, which serves as a bridge between integral and convolutional approaches.

The most innovative contribution from this list is the theory and practical implementation of differential offset continuation.

Evidently, more experiments will be needed before the methods developed in this dissertation appear in the active toolbox of modern seismic data processing. I hope that the future researchers will fully explore the research directions uncovered in this dissertation.

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