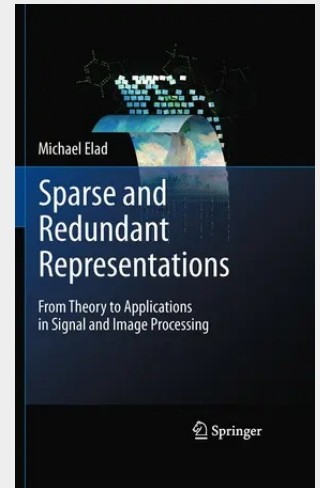


Sparse and Redundant Representations

From Theory to Applications in Signal and Image Processing

A long long time ago, echoing philosophical and aesthetic principles that existed since antiquity, William of Ockham enounced the principle of parsimony, better known today as Ockham's razor: "Entities should not be multiplied without neces sity." This principle enabled scientists to select the "best" physical laws and theories to explain the workings of the Universe and continued to guide scienti?c research, leadingtobeautifulresultsliketheminimaldescriptionlength approachtostatistical inference and the related Kolmogorov complexity approach to pattern recognition. However, notions of complexity and description length are subjective concepts anddependonthelanguage"spoken"whenpresentingideasandresults. The?eldof sparse representations, that recently underwent a Big Bang like expansion, explic itly deals with the Yin Yang interplay between the parsimony of descriptions and the "language" or "dictionary" used in them, and it became an extremely exciting area of investigation. It alreadyyielded a rich crop of mathematically pleasing, deep and beautiful results that quickly translated into a wealth of practical engineering applications. You are holding in your hands the ?rst guide book to Sparseland, and I am sure you'll ?nd in it both familiar and new landscapes to see and admire, as well as ex cellent pointers that will help you ?nd further valuable treasures. Enjoy the journey to Sparseland! Haifa, Israel, December 2009 Alfred M. Bruckstein vii Preface This book was originally written to serve as the material for an advanced one semester (fourteen 2 hour lectures) graduate course for engineering students at the Technion, Israel.

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