Preface

1 Welcome to "Matrix Information Geometry"

This book is the outcome of the Indo-French Workshop on "Matrix Information Geometries (MIG): Applications in Sensor and Cognitive Systems Engineering," which was held at École Polytechnique and Thales Research and Technology Center, Palaiseau, France, in February 23–25, 2011.

The workshop was generously funded mostly by the Indo-French Centre for the Promotion of Advanced Research (IFCPAR). During the event, 22 renowned invited French and Indian speakers gave lectures on their areas of expertise within the field of matrix analysis and processing.

From these speakers, a total of 17 original contributions or state-of-the-art chapters have been prepared in this edited book. All articles were thoroughly peer-reviewed (from 3 to 5 reviewers) and improved according to the suggestions, remarks or comments of the referees.

For the reader's convenience, the 17 contributions presented in this book are organized into three parts, as follows:

1. State-of-the-art surveys & original matrix theory papers,
2. Advanced matrix theory for radar processing,
3. Matrix-based signal processing applications (computer vision, economics, statistics, etc.)

Further information including the slides of speakers and photos of the event can be found on-line at:

http://www.informationgeometry.org/MIG/

2 Group Photo (24th February 2011)

This photo was taken in the "Cour Ferrié" of École Polytechnique, France

3 Organization

The 17 chapters of the book have been organized into the following three parts:

1. State-of-the-art surveys & original matrix theory work:

- Supremum/infimum and nonlinear averaging of positive definite symmetric matrices (*Jesús Angulo*)
- The Riemannian mean of positive matrices (*Rajendra Bhatia*)
- The geometry of low-rank Kalman filters (*Silvère Bonnabel and Rodolphe Sepulchre*)
- KV cohomology in information geometry (*Michel Nguiffo Boyom and Paul Mirabeau Byande*)
- Derivatives of multilinear functions of matrices (*Priyanka Grover*)
- Jensen divergence-based means of SPD matrices (*Frank Nielsen Meizhu Liu, Baba C. Vemuri*)
- Exponential barycenters of the canonical Cartan connection and invariant means on Lie groups (*Xavier Pennec and Vincent Arsigny*)

2. Advanced matrix theory for radar processing:

- Medians and means in Riemannian geometry: existence, uniqueness and computation (*Marc Arnaudon, Frédéric Barbaresco and Le Yang*)

- Information geometry of covariance matrix: Cartan-Siegel homogeneous bounded domains, Mostow/Berger fibration and Fréchet Median (*Frédéric Barbaresco*)
- On the use of matrix information geometry for polarimetric SAR image classication (*Pierre Formont, Jean-Philippe Ovarlez, and Frédéric Pascal*)
- Doppler information geometry for wake turbulence monitoring (*Zhongxun Liu and Frédéric Barbaresco*)

3. Matrix-based signal processing applications:

- Review of the application of matrix information Theory in Video Surveillance (*M.K. Bhuyan and Malathi.T*)
- Comparative evaluation of symmetric SVD algorithms for real-time face and eye tracking (*Tapan Pradhan, Aurobinda Routray, and Bibek Kabi*)
- Real-time detection of overlapping sound events with non-negative matrix factorization (*Arnaud Dessein, Arshia Cont, Guillaume Lemaitre*)
- Mining matrix data with Bregman matrix divergences for portfolio selection (*Richard Nock, Brice Magdalou, Eric Briys, and Frank Nielsen*)
- Learning mixtures by simplifying kernel density estimators (*Olivier Schwander and Frank Nielsen*)
- Particle filtering on Riemannian manifolds: Application to covariance matrices tracking (*Hichem Snoussi*).

Besides keywords mentioned at the beginning of each chapter, a global index of terms is provided at the end of the book.

4 Sponsors

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- École Polytechnique, and specially the Computer Science Department (LIX) of Ecole Polytechnique
- CEREGMIA, University of Antille-Guyane, Martinique.
- Sony Computer Science Laboratories Inc
- Thales

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CEFIPRA/Ecole Polytechnique/LIX/Sony Computer Science Laboratories/Thales

CEREGMIA, UAG

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It is our hope that this collection of contributed chapters presented in this book will be a valuable resource for researchers working with matrices, and for graduate students. We hope the book will stimulate further research into this fascinating interface of matrices, geometries and applications.

April 2012   Prof. Frank Nielsen
                                                                                       Prof. Rajendra Bhatia

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