

MHRD Scheme on Global Initiative of Academic Networks (GIAN)

MATHEMATICAL METHODS FOR IMAGE PROCESSING

Overview

Imaging and image processing has taken a considerable lead in the contemporary scientific world due to its capability to cater to a wide range of applications in today's technical world. Mathematical methods are inevitable to deal with digital images as these images are stored as matrices on storage devices. The literature on the subject is abundant and addresses various inverse problems such as image restoration, segmentation, registration and analysis in various contexts. Image restoration, for instance, encompass many applications such as denoising, deblurring, de-mosaicking, compressed-sensing/reconstruction, inpainting, restoration of compressed or quantized images... and is of key importance because it can be applied to many kind of images (natural, medical, remote sensing, biological, astronomical ...).

Among the wide range mathematical frameworks the models based dimensionality reduction technique are of a particular importance. They either rely on well-chosen transforms (such as Fourier, wavelet, curvelet...) or calculus of variation or both. For years, many variational models have (empirically) reached state of the art performances on many such applications. They often rely on strong theoretical guarantees (such as the non-linear approximation and compressed sensing theorems). Their resolution requires constructing and studying of efficient numerical algorithm for performing the minimization. To be efficient, these fast algorithms need to exploit the rich geometrical structures of these problems and the numerical constraints.

The course is expected to cover the fundamentals concepts in imaging and image processing transforms and variational models. Various optimization techniques (designed to solve smooth or non-smooth problems) will be presented. The general guideline for designing restoration models will be provided. In particular, various regularization methods will be discussed and analyzed during the course. Practical examples such as denoising, deblurring and inpainting, will be entirely studied in all there details during the hands-on sessions. The foundations of the theoretical justifications will be presented.

The course is expected to provide the participants with an adequate exposure to the mathematical concepts for solving the real-world image processing problems using variational framework. Students and researchers from various disciplines such as computer science, electronics engineering and mathematical sciences are being expected to attend the course and get benefited from the same.

Objectives

The primary objectives of the course are as follows:

- i) Exposing participants to the fundamentals aspects of the modeling, the theoretical justification and numerical resolution in image processing,
- ii) Providing adequate preliminary inputs to understand the concepts required for analyzing the theory behind the problem.

- iii) Extending the theoretical concepts towards applications and providing hands on experience in solving real world problems.
- iv) Building in confidence and capability amongst the participants in the application of the methods in other relevant areas in science and engineering like robotics, computer vision etc.
- v) Providing exposure to some real-time imaging problems and their solutions, through mini projects and demos,

Course duration	23 rd to 27 th October, 2017
Host Institute	National Institute of Technology Karnataka, Surathkal
Maximum number of participants	60
Who should attend?	Faculty, scientists, researchers from industry and students working in various science & engineering disciplines like computer science, electronics and communication, computational methods, applied mathematics etc...
Fees	Faculty, academic staff : Rs. 4000 Persons from industry: Rs.6000/- Students: Rs. 1000/- Foreign Participants: US \$200 This registration fee includes instructional materials, use of computers for lab and tutorial purpose and inter-session refreshments. Participants are advised to make arrangements for their stay during the course.

The faculty



Prof. Dr. Francois Malgouyres is currently a professor in the Institute of Mathematics of Toulouse, Faculty of Science and Engineering, Universite Paul Sabatier, France. Dr. Malgouyres completed his Ph.D in 2000 in the field of image processing from CMLA, France under the supervision of Prof. Jean-Michel Morel and Prof. Bernard Rougé. He has published several scholarly research articles in various internationally reputed journals and selected conferences. Before joining the university of Paul Sabatier he had worked as a CAM Assistant Professor in the Department of Mathematics UCLA. He had served in various roles such as Deputy member of the CNU, deputy director of FREMIT etc. He also serves as the member in various reputed scientific councils and societies. His areas of research interest include mathematical methods in image processing, numerical algorithms for image processing, variational models in imaging and image processing etc.

Host Faculty



Dr. Jidesh P. Completed his Ph.D. degree in Image restoration from National Institute of Technology Karnataka. Presently he is working as an Assistant Professor in the Department of Mathematical and Computational Sciences, National Institute of Technology, Karnataka. His areas of research interest include mathematical imaging and image processing. He has published several papers in international journals and conferences.

Course Coordinator:

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