instituto de telecomunicações

PROJECT / Regularization Criteria and Fast Algorithms for Imaging Inverse Problems

ReAlImage

Main Objective:

The goal of the project is to advance the state of the art in criteria and algorithms for solving imaging inverse problems. The research fronts that we aim to push forward are the following:

a) In standard photography, and even more in computational photography (CP), deconvolution plays a key role. In the standard case, deblurring is used to compensate lens softness, while in many CP applications (e.g., coded aperture) deconvolution is itself responsible for producing the images. Even with the CP "friendly" direct operators, prior knowledge (regularization) is required to solve the IP. In this work front, we will develop new regularization criteria, beyond the currently used sparseness-inducing 1-norm and total-variation. In particular, we will consider: compound regularizers; criteria that adapt automatically to the intrinsic complexity and/or the local structure of the underlying image; non-local regularization (which has only been used for pure denoising problems, with excellent results).

b) Realistically, full knowledge about the convolution operator is seldom available: the exact motion causing a motion blur is of course unknown; coded aperture imaging is highly sensitive to the exact knowledge of the aperture, which is usually obtained by a previous careful calibration procedure. These observations stress the general importance of blind deconvolution. In this topic, we will
research criteria for blind deconvolution, for problems with varying degrees of uncertainty about the direct operator. In particular, we will take steps towards the ''holly grail'' of blind deconvolution: an objective function whose minimization yields optimal image and convolution estimates.

c) Some of the currently fastest algorithms for CS and image deconvolution under standard regularizers were developed by researchers in the project team. The new criteria mentioned in (a) and (b) will result in new, more challenging optimization problems, requiring new algorithms. This will be the third core research direction of the project, continuing our successful recent line
of work. Bregman iterations and augmented Lagragian methods will be fundamental tools in our quest.

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