
PROGRAMA DE VERÃO 2023 - 709

ESCOLA DE MATEMÁTICA APLICADA FGV EMap

DISCIPLINA: Convex optimization in image processing

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CARGA HORÁRIA: 06

PRÉ-REQUISITO:

PERÍODO: 23/01 a 27/01

HORÁRIO: 10h as 12h

PLANO DE ENSINO

1. Ementa

In this lecture we explore some basic elements of convex optimization applied to image and signal processing. The lecture is divided in three main parts. In the first part, we start by defining the deblurring and denoising problems and we study different regularizations, including ℓ_1 , ℓ_2 , $TV - \ell_1$, and $TV - \ell_2$ regularizations. We further study the convex analytical

properties of smooth and non-smooth convex regularizations, including the concepts of gradient and proximity operators.

In the last two parts, we provide globally convergent algorithms for approximating a deblurred/denoised image from a blurred/noised observation. In the second part we focus on convex smooth optimization problems, which includes ℓ_2 regularizations for deblurring and/or denoising. In the third part we study convex nonsmooth optimization problems, which includes ℓ_1 regularizations for deblurring and/or denoising. In all parts we provide numerical simulations in Python in order to illustrate the advantages and disadvantages of the proposed algorithms.

1. Part I: Convex functions in signal and image processing.

- Deblurring and denoising problems.
- Discrete gradient.
- ℓ_1 and ℓ_2 regularizations.
- Existence and uniqueness of solutions for convex optimization problems.
- Smooth convex optimization problems: gradient
- Non-smooth convex optimization problems: proximity operator.

2. Part II: $TV - \ell_2$ regularization: smooth convex functions.

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- TV – ℓ_2 denoising.
 - TV – ℓ_2 deblurring.
 - Appendix.
3. Part III: TV – ℓ_1 regularization: non-smooth convex functions.
- TV – ℓ_1 denoising.
 - TV – ℓ_1 deblurring.
 - Concluding remarks.

2. Procedimentos de avaliação

Não será aplicado avaliação durante o curso.

3. Bibliografia Obrigatória

4. Mini Currículo

