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VARIATIONAL METHODS AND PDEs AND OPTIMISATION FOR IMAGE PROCESSING

1. SYLLABUS INFORMATION

1.1. Course title
Variational Methods and PDEs and Optimisation for Image Processing

1.2. University
Université de Bordeaux

1.3. Semester
2nd year, 1st semester

2. COURSE DETAILS

2.1. Course nature
Compulsory

2.2. ECTS Credit allotment
6

2.3. Recommendations
Basic knowledge in linear algebra, differential calculus, finite dimension vectorial spaces, Matlab.

2.4. Faculty data
Prof. Jean-François Aujol – IMB
firstname.lastname@u-bordeaux.fr
https://www.math.u-bordeaux.fr/~jaujol

3. COMPETENCES AND LEARNING OUTCOMES

3.1. Course objectives

A first objective of this class is to present variational approaches and partial differential equations in image processing. The students will learn to mathematically model image processing problems. Students are given the basis in order to be able to adapt classical variational models and PDEs to situations they might encounter in their future professional life.

A second objective of this class is to introduce some basics of optimization. Thanks to the first part of the course, the students can propose mathematically sounded criterion to minimize. They then need to be able to efficiently tackle them, which is the second objective of this course.

Practical labs will illustrate the theoretical principles developed in the course.

3.2. Course contents

1. PDEs in image processing
- Convolution
- Heat equation
- Nonlinear PDEs

2. Variational methods in image processing
- Tychnonov regularization
- Nonlinear regularization
- Functions with bounded variations
- The direct method of the calculus of variations

3. Optimization
- Convex functions
- Euler equation
- Smooth optimization
- Nonsmooth optimization

3.3. Course bibliography

G. Aubert, P. Kornprobst, "Mathematical Problems in Image Processing, Partial Differential Equations and the Calculus of Variations", Springer, 2006

4. TEACHING-AND-LEARNING METHODOLOGIES AND STUDENT WORKLOAD

Activity	Hours
Lectures	20
Tutored computer lab	28

*Classroom instruction: 33%
Independent study time: 66%

5. EVALUATION PROCEDURES AND WEIGHT OF COMPONENTS IN THE FINAL GRADE

Evaluatory activities:
- Lab assignments
- Written test