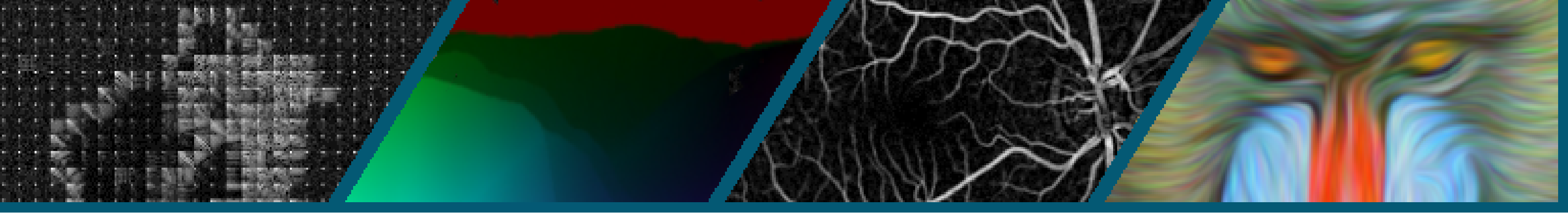


Mathematical Image Analysis Group

Differential Equations in Image Processing and Computer Vision

Winter term 2023
Saarland University

UNIVERSITÄT DES SAARLANDES

Dr. Pascal Peter

Important Information at a Glance

Lectures

- Tuesday 8:30-10:00 (Building E1.3, HS001)
- Friday 14:15-16:00 (Building E1.3, HS001)
- *You can attend the live lectures either in person or on Teams. Recordings will be available. Access to Teams and lecture materials will be granted after your registration in the CMS:* *https://cms.sic.saarland/dic23*
- First Lecture: **24.10.2023**

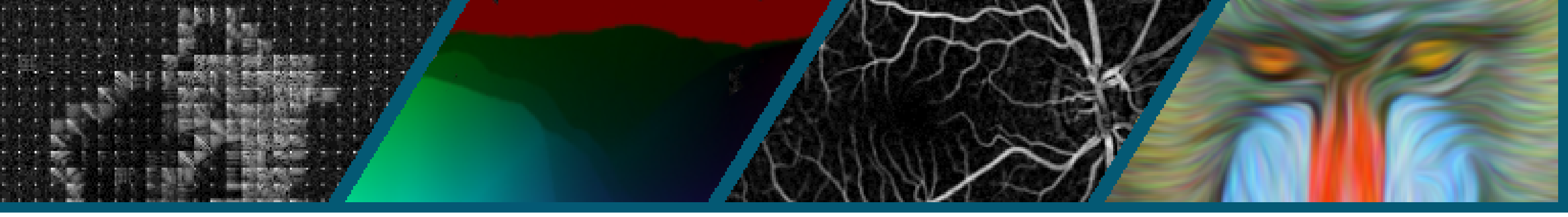
Tutorials

- Hand in homework assignments in a group of up to 3 students. (24 points)
- Discuss class room work assignments in group work. (12 points for individual attendance)
- **You need to register for a tutorial group in the CMS.**
- **Use Teams to find a group or join the group roulette (random assignment)!**

Exams

- admission: 312/468 tutorial points (13 tutorials)
- closed book: You can bring a handwritten sheet of notes, but no other materials.
- dates: **19.02.2024** and **08.04.2024**, 14:00-17:00
- The better grade counts.
- **Exams require** LSF **registration!** (Starts a few weeks into the semester.)

This flyer intends to answer your most important questions about DIC and should help you to decide if the lecture is interesting for you. For even more details on the organisation of the course, check out our introduction lecture and the guided tour on MS Teams (after registration).



A Word of Welcome

Lecturer

Pascal Peter

I am excited to have another opportunity to offer DIC again this semester, five years after the last time. It is an excellent opportunity for students who want to deepen their understanding of mathematically well-founded visual computing. In my own time as a student, I saw it as a great follow-up to the lecture *Image Processing and Computer Vision*, which is still true today. However, the lecture also works very well as a standalone course.

This document is intended to provide you with the basic information that you need in this semester. If it manages to awaken your interest in the course, I would be happy to welcome you in the introductory lecture on 24.10.2023. After registration, you will also gain access to a little guided tour that will help you to get more detailed organisational information.

Building on experiences from the previous semesters, the lecture is offered in a hybrid format with live lectures that can be attended either in person or online. I am convinced that good communication is one of the key elements of a successful lecture. Thus, I am looking forward to connecting to you either in person or via Teams. Do not hesitate to contact me if you have questions. Moreover, our tutorials are designed to promote active problem solving instead of passive consumption of solutions. In group work with your fellow students, you will tackle assignments that are not redundant to the homework. Teaching staff will be there to assist you and to assess your solutions.

I hope you will enjoy this course and look forward to discussing with you in the lectures.

– Pascal Peter

The Tutor Team

Since our tutorials are designed to be active and an integral part of the lecture, we have a motivated team of tutors to assist you and answer your questions. For organisational issues, please contact our head tutor Michael Ertel via Teams or mail (ertel@mia.uni-saarland.de).

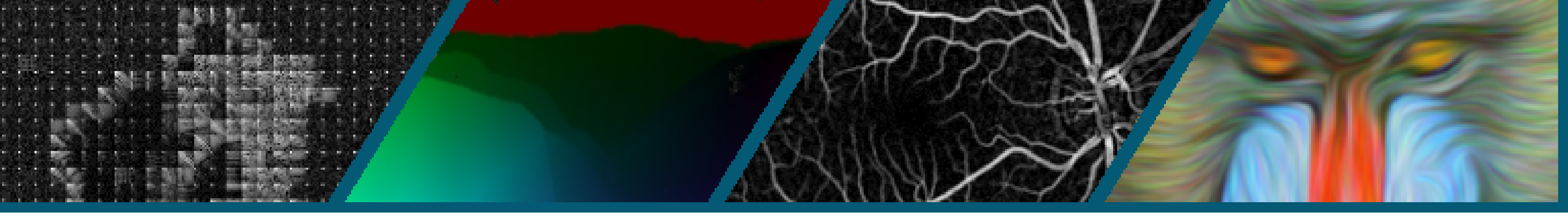
Head Tutor

Michael Ertel

Tutors

Soumava Paul

Harishanth Sivakumaran



Teaching Goals

After attending the lecture you should ...

- understand the basic ideas behind the most important visual computing methods based on differential equations, in particular their advantages and shortcomings,
- be able to find or design an appropriate method for a task at hand,
- understand the basic algorithms for concrete implementations,
- be well-equipped to start a master thesis in our group.

Content

In the lecture we will discuss the following topics.

Diffusion and Osmosis Processes

- linear and nonlinear diffusion models, osmosis models
- continuous and discrete theory
- efficient algorithms and parameter selection

Variational Methods

- continuous and discrete models
- TV regularisation and primal dual approaches
- a unified framework for denoising
- image sequence analysis

Morphology

- shape analysis, curve evolutions and connections to differential equations
- shock filters, mean curvature motion, affine morphological scale-spaces
- self-snakes, active contours

Image Compression with Partial Differential Equations

- data selection: sparse representation by small fraction of image pixels
- decoding by diffusion-based image reconstruction