Digital Image Analysis for Scientific Applications

ECTS credits: 8 for the whole course, 5 for part 1 of the course

Course period: October-December 2020

Maximum number of participants: 40

Language of instruction: English

Contact person
Damian Matuszewski, damian.matuszewski @it.uu.se

Application from course participants should be sent to
Damian Matuszewski, damian.matuszewski @it.uu.se
Not later than: 21 September 2020

Recommended prerequisites
The target group is PhD students from all subjects where digital image analysis (IA) is used as a research tool. No previous experience in IA is required from the course participants, but an interest in its potential as a tool in their own research is important. The course can be followed with a basic knowledge of mathematics (corresponding to upper-secondary level entry requirements) and basic computer skills. In the second part of the course, we plan to have a set of lectures focused on IA usage in the research domains in which we have extensive experience and for which we expect many students: microscopy, radiology, materials science and medical engineering. To match all students’ interests, we will use our IA network and tailor lectures/literature suggestions to fit specific research areas where IA is used. By using this flexible structure, we want to attract students from all sections within the TekNat Faculty, including life science, medical engineering, and materials science.

General course objectives and learning outcomes
The course participants will study literature relevant to their PhD project, practice their ability to scientific analyses, find and test appropriate IA methods, and present and discuss their scientific results.

Course Aim
Today, many research projects at the TekNat Faculty, in areas as diverse as biology, chemistry, materials science, and astronomy, require imaging and the analysis of images. Digital image analysis (IA) has become an indispensable tool for objective, quantitative and fast analysis of large amounts of image data. Such analyses are often needed to extract specialized knowledge and increase the scientific value of image-based experiments. A number of IA tools are available, but in order to use them in a correct and meaningful way, a basic understanding of the underlying methods is necessary. This course aims at giving doctoral students from across the faculty sufficient understanding to solve basic IA problems. The course will also offer an introduction to freely available software tools, as well as Matlab, preparing the students to start using IA in their own research.

1See the research projects, list of publications and list of cooperation partners in the Centre for Image Analysis Annual report, http://www.it.uu.se/cba/files/AR2019.pdf
Contents, study format and form of examination

The focus of the course is on reaching a broad understanding of IA and a basic understanding of the theory and algorithms behind the IA methods. The course starts with basic IA methods and computer exercises, including IA research methodology and IA research ethics. In the second part of the course, participants choose at least four lectures/computer exercises to tailor the course to match their own research interest (see Fig 1).

The examination will be divided into:

- three computer exercises, both to get familiar with the interfaces of common software and to solve realistic image processing problems,
- a written exam on part 1,
- a project (oral presentation and written report), where the course participants apply the collected knowledge to a project within their own domain.

The course participants will study literature relevant to their project, practice their ability to scientific analyses, find and test appropriate IA methods, and present and discuss their scientific results. The course participants will get eight credits for taking the whole course, or five credits for taking part 1.

**Figure 1:** Course structure. The first part gives 5 ECTS credits, and the whole course, part I and II, gives 8 ECTS credits. The lectures in the second part will be adjusted to match the students’ research interest. We will invite guest lecturers when needed.
**Department with main responsibility**
Dept. of Information Technology, Division of Visual Information and Interaction, Vi2

**Other departments involved**
We have previous and current collaborations on application oriented research projects together with many departments within the TekNat Faculty. In areas where we lack experience, we plan to work with examples from literature or invite lecturers from other image analysis groups to cover the research areas relevant for the participating doctoral students. The course is organized in collaboration between SciLifeLab and Vi2.

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**More info**
http://cb.uu.se/~damian/DIASA_2020/index.html