Visualization technology and methodology

/ Visualiseringsteknik och -metodik /

SCB code: 10201

1 General description of the research area

Visualization technology and methodology is an engineering subject, focusing on data and its human uses. The subject combines technology and design of interactive data processing, visualization and other modes of perceptualization[1].

Important research areas within the subject are:

- Perceptualization technologies
- Visual analytics
- Data science
- Computer graphics
- Computational imaging
- Visual machine learning
- Human-centered perceptualization
- Image reproduction

Visualization technology and methodology is applied in many domains, including science communication, medical imaging, industrial automation, environmental science, cultural heritage and decision support. Research results in the subject comprise specific contributions to the core research areas, as well as theoretical and philosophical contributions.

2 Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*.

2.1 Specific eligibility requirements

Specific eligibility requirements for PhD education in Visualization Technology and Methodology are met by those who have completed course requirements of at least 60 ECTS at the master's level in a research field relevant to the subject of the PhD studies or equivalent knowledge and skills.

3 Degree

PhD studies in Visualization Technology and Methodology lead to a Degree of Doctor or a Degree of Licentiate. The latter degree can also serve as a stage in the PhD studies. The Degree of Licentiate comprises 120 ECTS, of which the licentiate thesis corresponds to 75 ECTS, and courses of 45 ECTS of which at least 35 ECTS must be at PhD level. The Degree of Doctor comprises 240 ECTS, of which the doctoral thesis corresponds to 180 ECTS, and courses of 60 ECTS, of which at least 45 ECTS must be at PHD level. The distribution between the course credits and the thesis credits is regulated in the first individual study plan that is established.

4 Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook*'s appendix A).

The education enables the PhD student to acquire both in-depth and broad knowledge and understanding within the research area of medical technology by:

- The PhD student acquires broad knowledge and understanding within the subject by, e.g., attending breadth-oriented third-cycle courses, collaborating with other research communities, teaching in undergraduate courses within the subject, etc.
- The PhD student acquires deep knowledge and understanding within the subject, and specifically within the chosen direction of research, by, e.g., attending specialized in-depth third-cycle courses, performing independent research work in one or more research projects, engaging in in-depth discussions at seminars and conferences, etc.
- The PhD student develops familiarity with scientific methods by attending methodological third-cycle courses and by planning, performing and reflecting upon own research.
- The PhD student develops skills and abilities within the subject by, e.g., planning and executing own research, communicating research results in national and international fora, engaging in reflection and discussion of own research as well as that of others, engaging in the academic community work of peer reviewing and event planning, regularly reflecting on study progress and the way forward, etc.
- The PhD student develops academic judgment and approach by attending mandatory third- cycle learning activities in research ethics, engaging in reflective discussions in seminars and conferences, etc. Intellectual autonomy is demonstrated in the individual writing and defense of a dissertation.

The goal of doctoral education is for the PhD student to independently conduct and lead research and development projects, particularly within the field's operational framework. To achieve this goal, the PhD student needs to develop advanced and deep knowledge within the subject, as well as specific expertise in the dissertation area, along with research experience and proficiency in research methodology.

PhD studies in Visualization Technology and Methodology provide the PhD student with the conditions to meet all degree objectives. The education consists of research and dissertation work, courses, participation in seminars, involvement in national and international conferences, and collaboration with society and industry within the subject area.

The education enables the PhD student to acquire both in-depth and broad knowledge and understanding within the research area of medical technology by:

- Completing broadening courses in medical technology science.
- Completing advanced courses in line with the direction of the dissertation work.
- Independently planning and conducting theoretical and/or experimental research.
- Actively following the literature within the subject.
- Actively participating in teaching within and/or outside LiU.

As part of the PhD studies, the PhD student is given the opportunity to develop familiarity with scientific methodology and ethics. The PhD student is also given the opportunity to acquire and develop skills and abilities within the subject, as well as to develop evaluative skills and approaches within the subject, by:

- Completing a faculty-required course that includes research methodology and research ethics.
- Independently identifying and formulating relevant research questions within their own research.
- Independently planning and conducting theoretical and/or experimental research.
- Conducting a midway seminar to achieve 60% of the requirements for the doctoral degree. This applies to PhD students enrolled in a doctoral program who do not conduct a licentiate seminar.
- Regularly presenting their own research at seminars at LiU.
- Regularly presenting their own research at national and international conferences within the subject.
- Actively participating in seminar series and conferences to discuss and critically evaluate their own and others' research.

PhD students in Visualization Technology and Methodology demonstrate intellectual independence by independently writing a monograph dissertation or a frame narrative (part of a compilation thesis).

The education provides the PhD student with an in-depth insight into the possibility of science to contribute to sustainable social development. This is achieved by the faculty common course requirements, as well as through participation in ongoing discussions, such as research seminars, and reflecting on the sustainability aspects of their own research work.

4.1 Thesis

The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*.

The PhD student demonstrates their ability to significantly contribute to the development of knowledge through their own research by writing a doctoral or licentiate thesis, the scientific quality of which must be approved by a grading committee (for the doctoral thesis) or an examiner (for the licentiate thesis).

A PhD or licentiate thesis can either be a monograph or a compilation thesis. A compilation thesis consists of a summary and a number of articles. In both types of theses, however, it is the overall scientific contribution that is assessed, and the requirement in both cases is that the thesis contains scientific contributions that are considered publishable in established scientific forums.

4.1.1 PhD Thesis

The thesis should be of such a quality that it is deemed to meet reasonable requirements for acceptance for publication in a high-quality international journal. In the thesis, the student's own research should be introduced, discussed, and critically evaluated in relation to the broader research field. A compilation PhD dissertation in Visualization Technology and Methodology usually contains at least four articles, of which the majority should be published.

4.1.2 Licentiate Thesis

The thesis should consist of a scientific paper or a research report based on scientific principles. A licentiate thesis in Visualization Technology and Methodology is either a scientific thesis or a report based on scientific method

4.2 Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year.

4.3 Supervision

The general regulations for supervision can be found in the *Study Handbook for PhD Studies*, section 4, and in the faculty's policy for supervision of PhD studies.

4.4 Courses

4.4.1 Faculty course requirements

Scientific theory, methodology, ethics, gender equality and sustainability
All PhD students admitted should complete mandatory courses as decided by the faculty in Scientific theory, methodology, ethics, gender equality and sustainability, or be deemed to have equivalent competencies, in order to receive a degree.

Pedagogic studies
All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

4.4.2 Subject related courses

It is recommended that PhD students take the course Introduction to PhD studies in Visualization Technology and Methodology at an early point of their studies. Moreover, it is recommended that PhD students take the courses Mathematical Foundations of Visualization Technology and Methodology as well as Research Methodology for Visualization Technology and Methodology.

4.4.3 Accreditation

Accreditation of course credits is regulated by the *Study Handbook for PhD studies*, section 5.6.

5 Other information

5.1 Transitional provisions

Changes to the general study syllabus do not apply to those who have already been admitted to PhD studies in the research area. A change to the new general study syllabus may however be approved if both the main supervisor and the PhD student agree. In such a case, this should be documented in the individual study plan.

6 Commencement

1. The General study plan comes into force 01 06 2025.