MS and PhD in Spatial Information Science and Engineering:

UMaine Grad Catalog Description for 2020-2021

Spatial Information Science and Engineering

The graduate programs in Spatial Information Science and Engineering focus on advancing knowledge about spatial information particularly with respect to concepts needed in next-generation information systems. Emphasis is placed on developing novel concepts and methods in the broad field of geographic information science for sensing, storing, accessing, analyzing, and managing spatial data as well as modeling, extracting, integrating, visualizing, and communicating spatial information.

Students build on a solid foundation in computer science, mathematics, physics, geography, cognitive science, artificial intelligence, engineering and related fields to study spatio-temporal phenomena and design intelligent spatial information systems. In addition to these concepts, the design of spatial information technologies requires a comprehensive understanding of the social, legal, economic, and institutional issues affecting such systems, a commitment to human users and ethical uses of such systems, dedication to the ethics of broad access to information, and commitment to quality of information.

The research interests of our faculty are currently predominantly in the area of Spatial Computing, including spatial cognition, spatio-temporal reasoning, spatial ontologies, spatio-temporal data streams, geosensor networks, spatial data science, and location privacy.

Graduate programs offered include the Ph.D. in Spatial Information Science and Engineering, Master of Science in Spatial Information Science and Engineering, Master of Science in Spatial Informatics, and Graduate Certificate in Geographic Information Systems.

Objectives of these programs include:

The core objectives of the graduate programs include interdisciplinary study of the nature and function of spatial information systems, and the technical study of the design and evaluation of methods and processes to capture, represent and analyze spatial information.

Graduate courses cover formal representations of spatial phenomena, database systems, geographic information systems, human-centered design, and information policy. Research topics may be selected from any of the principal areas ranging from geographic information science, spatial cognition and spatial interface design, spatial database systems, artificial intelligence involving spatial information, geosensor networks, to legal and policy studies addressing location technology uses and advancements. Many research topics require an interdisciplinary approach and,

therefore, courses taught in other graduate programs complement the programs offered.

Supplemental information supporting the program and course requirements that follow may be found in the current edition of the Graduate Student Guide available through the Spatial Informatics website.

Master of Science in Spatial Information Science and Engineering

The School of Computing and Information Science offers both a thesis and project option in the Master of Science in Spatial Information Science and Engineering. All work for a master's degree must be completed within six years. The timing starts with the first semester of registration after admission to the Master of Science in Spatial Information Science and Engineering.

The thesis option is the scientific track, typically requiring a strong engineering, computer science, human-computer interaction, or mathematics undergraduate background. Prospective master's students with other disciplinary backgrounds are expected to make up the requisite math and engineering courses that would allow them to succeed in an engineering graduate curriculum. The thesis option includes a substantial piece of individual research as a basis for a master's thesis.

The project option is aimed at students who desire to focus primarily on course work rather than research at the master's level. The formal coursework is complemented by a one-semester project in which the student must demonstrate that he or she can apply the acquired knowledge for implementing a particular solution.

Degree Requirements

Master (Project Option)

Minimum of 30 graduate course credits (i.e., 400 level or above) on a program of study approved by advisors that includes:

- At least 12 graduate course credits at 500 level or above
- At least 18 graduate course credits in SIE
- No more than 6 credits of independent study courses (598, 698, or equivalent independent study courses in other graduate programs)
- SIE 589 Graduate Project (3 credits)
- SIE 507 Information System Programming
- INT 601 Responsible Conduct of Research (1 credit)
- Breadth Requirement: at least one 3-credit graduate course from 4 out of the 5 following breadth areas:
    - Formal Representations of Spatial Phenomena

    - Spatial Cognition and Interaction
    - Database Systems
    - Geographic Information Systems
    - Information Policy
- At least 3 graduate faculty on the advisory committee
- At least 2 must be SIE tenured or tenure-track faculty

Master (Thesis Option)

Minimum of 30 graduate course credits (i.e., 400 level or above) on a program of study approved by advisors that includes:

- At least 24 graduate course credits
- At least 6 thesis credits - SIE 699
- At least 12 graduate course credits at 500 level or above
- At least 18 graduate course credits in SIE
- No more than 6 credits of independent study courses (598, 698 or equivalent independent study courses in other graduate programs)
- SIE 501 Introduction to Graduate Research (1 credit)
- SIE 502 Research Methods (1 credit)
- SIE 507 Information System Programming (3 credits)
- SIE 693 Graduate Seminar (1 credit)
- INT 601 Responsible Conduct of Research (1 credit)
- Breadth Requirement - at least one 3-credit graduate course from 3 out of the 5 breadth areas:
    - Formal Representations of Spatial Phenomena
    - Spatial Cognition and Interaction
    - Database Systems
    - Geographic Information Systems
    - Information Policy
- At least 3 graduate faculty on the advisory committee
- At least 2 must be SIE tenured or tenure-track faculty
- Master's Thesis Defense

For either master's degree, a maximum of six credit hours of graduate course work taken prior to enrollment in the master's program, whether at this university or another, may be counted towards the master's degree. If the course did not count towards a completed undergraduate degree and if the student's graduate advisory committee formally approves acceptance of the courses on the student's Program of Study, then the credit hours may be transferred to apply toward the master's degree.

In order to meet the University of Maine Graduate School residency requirement, at least 50 percent of the coursework towards the degree must be taken through the University of Maine, whether on-campus or online. Requirements for on-campus

presence for research and project work are at the discretion of the student's first advisor and advisory committee.

Doctor of Philosophy in Spatial Information Science and Engineering

The Ph.D. degree is the highest of academic degrees. The Ph.D. in Spatial Information Science and Engineering is awarded to those demonstrating outstanding achievement in Spatial Information Science and Engineering scholarship and primarily for demonstrated ability for independent research in the field. The preparation and defense of a dissertation embodying the results of an original investigation in a specialized area of Spatial Information Science and Engineering are essential features of the program.

All work for a doctoral degree must be completed within eight years. The timing starts with the first semester of registration after admission to the Ph.D. in Spatial Information Science and Engineering. Students must be admitted to candidacy within four years of registration for the first work presented for satisfaction of degree requirements. To be admitted to candidacy, the student must develop a dissertation proposal and orally defend it successfully in front of the student's graduate advisory committee. The dissertation proposal and its defense must demonstrate the student's knowledge related to the student's dissertation topic. The dissertation must be completed within four years of admission to candidacy. A full oral defense of the dissertation is required upon successful completion of the student's work.

For admission, students normally are expected to hold a Master's degree with a strong technical and analytical background, typically in engineering, computer science, cognitive science, mathematics, geography, or another area related to their prospective advisor's research area. Graduate students without a Master's degree may be considered for direct admission to the Ph.D. program with approval by the graduate program faculty.

Degree Requirements

A minimum of 12 dissertation credits (SIE 699) and 30 graduate course credits (i.e., 400 level or above) on a program of study approved by the student's graduate advisory committee that includes:

- Up to 24 transfer credits of graduate course work
- SIE 507 Information System Programming
- At least 5 credits in Research Skills, including all of the following:
    - SIE 501 Introduction to Graduate Research (1 credit)
    - SIE 502 Research Methods (1 credit)
    - INT 601 Responsible Conduct of Research (1 credit)
    - SIE 693 Graduate Seminar (1 credit)
    - SIE 694 (1 credit) once a year starting the year after completion of SIE 693

- *Breadth Requirements*: at least one 3-credit graduate course from 4 out of the 5 following breadth areas:
    - Formal Representations of Spatial Phenomena
    - Spatial Cognition and Interaction
    - Database Systems
    - Geographic Information Systems
    - Information Policy
- *Depth Requirement*: At least 12 graduate credits (400 level or above) not counted towards the breadth requirement. These credits must be in areas relevant to the student's dissertation topic as determined by the student's advisory committee, with at least 6 of those credits from SIE courses.
- At least 5 graduate faculty on the advisory committee
- At least 3 must be SIE tenured or tenure-track faculty
- Dissertation Proposal Defense

A maximum of 24 credit hours of graduate course work taken prior to enrollment in the Ph.D. program, whether at this university or another, may be counted towards the Ph.D. degree. If the student's graduate advisory committee formally approves acceptance of a course on the student's Program of Study, then the credit hours may be transferred toward the doctoral degree.

The University of Maine Graduate School minimum residency requirement for the Ph.D. is automatically met by four semesters of course enrollment in the program beyond the baccalaureate degree, whether by on-campus or online enrollment. Requirements for on-campus presence for research and project work are at the discretion of the student's first advisor and advisory committee.

Admission Requirements

Admission to the University of Maine Spatial Information Science and Engineering graduate programs is competitive. In its admission process, the graduate faculty considers the potential of applicants to complete the program successfully and achieve positions of leadership in the private or public sectors. For all of our graduate programs we are generally seeking students that score at the mean or above on the verbal, quantitative and analytical segments of the GRE exam and in the 50th percentile or above on the exam overall. We generally seek an undergraduate grade point average of 3.0 or above. Exceptions are considered on a case-by-case basis. For applicants pursuing a non-thesis graduate degree, completion of the GRE Waiver Request may be appropriate.

At a minimum, an applicant must have a four-year U.S. bachelor's degree from an accredited college or university, or a four-year international equivalent. Within their curriculum, all applicants should have completed a university course in Algebra as a minimum math prerequisite for admission. Previous programming courses or experience are recommended but not required. The graduate faculty considers both the curriculum completed and the institution attended in its assessment.

All students apply through the Graduate School and typically the entire application packet including transcripts, test scores and letters of recommendation must be received before a formal acceptance will be issued. To be considered for Fall admission, completed applications should be received 8 weeks prior to the beginning of the term.

Note: Although recommended, students applying for *Graduate Certificate* programs are not required to submit GRE scores or letters of reference. Students that successfully complete a graduate certificate program in Information Systems or Geographic Information Systems (both offered on-campus and by distance) that includes the foundation courses of SIE 505, 507, 515, 525 and 550 in their certificate programs and receive a B or better in all of these courses are not required to submit a GRE score for admission to the full non-thesis MS programs in Information Systems (offered on-campus and by distance), Spatial Informatics (offered by distance only) and Spatial Information Science and Engineering - Project Option (offered on campus only). If admitted, the 5 foundation courses automatically count toward the 10 courses required for the full MS degree.

Four Plus One Program: Early Admission for UMaine Undergraduate Students

Undergraduate students from any degree program at the University of Maine may apply as early as the summer before their junior year for admission to the ***MS Spatial Information Science and Engineering (Project Option)*** graduate degree program. Applications for conditional "early admission" should be received preferably by the middle of the first semester of the junior year and are not accepted after the senior year has commenced.

By taking a course overload of three credits in the second semester of the Junior year and a course overloads in each of the semesters of the Senior year, a motivated student typically may acquire 9 credits (but no more than 12) for graduate school (at undergraduate tuition rates) prior to acquiring their undergraduate degree assuming that they receive a B or better in the courses. These courses, if chosen appropriately, may double count towards both the undergraduate and graduate degree. By taking a 3-credit Information Systems Internship graduate course with a corporation, agency or non-profit organization during the summer, a student may readily complete the coursework master's degree in a single year after their undergraduate degree. This master's degree will be highly complementary to an undergraduate degree in almost any field and attractive to employers.

To apply for early admission before or during the junior year, an applicant should expect to have an overall minimum undergraduate grade point average of 3.25, must have completed the University of Maine General Education Requirement in Math and must have three letters of recommendation from current or previous university instructors. Apply using the Application for Admission to the SIE or MSIS Four Plus One Program. Continuation in the graduate program is based primarily on performance in the graduate courses and overall grade point average upon graduation from the undergraduate program. Accepted *Four Plus One* students must complete the full graduate application in their senior year. The GRE exam is typically waived for these accepted high performing students. Below a 3.0 accumulated undergraduate grade point average should be assumed cause for discontinuation in the graduate program.

Students with two or fewer semesters remaining to complete their undergraduate degree program do not qualify for the "four-plus-one program" but their applications will be considered

as applications within the regular MSIS admissions process. In this case, one may transfer up to two graduate courses prior to formal admission.

Financial Assistance

In addition to University fellowships and scholarships listed elsewhere in this Catalog, the School of Computing and Information Science offers graduate research assistantships to qualified students on externally funded research projects. A very limited number of teaching assistantships may be available. Consult as well Funding at the Graduate School web site.

Graduate Faculty

M. Kate Beard-Tisdale, Ph.D. (Wisconsin, 1988), Professor. Geographic information systems, map generalization, data quality and its visualization, geographic information retrieval, spatio-temporal phenomena and information integration.
Max J. Egenhofer, Ph.D. (Maine, 1989), Professor. Qualitative reasoning, spatio-temporal reasoning, user interfaces for geographic information systems, design of spatial database systems, and mobile spatial information appliances.
Nicholas A. Giudice, Ph.D. (Minnesota, 2004), Professor and Chief Research Scientist of the VEMI Lab. Human computer interaction in real and virtual reality environments, indoor navigation, multimodal spatial cognition, information-access technology and multimodal spatial displays.
Torsten Hahmann, Ph.D. (Toronto, 2013), Associate Professor. Ontologies, especially spatial ontologies with application to earth and geoscience applications, ontology engineering, knowledge representation, automated reasoning, information extraction, artificial intelligence, and logic.
Silvia Nittel, Ph.D. (Zurich, 1994), Associate Professor and Director of Geosensor Networks Lab. Stationary and mobile sensor networks, decentralized in-network data collection algorithms for geosensor networks, management of distributed sensor data streams in real-time.
Harlan J. Onsrud, J.D. (Wisconsin, 1982), Professor and Graduate Coordinator. Legal, ethical, and institutional issues affecting creation and use of databases, ethics driven information systems design, assessment of social and societal impacts of spatial technologies.
Nimesha Ranasinghe, Ph.D. (Singapore, 2013), Assistant Professor. Research interests include Multisensory Interactive Media, Augmented Reality, and Human-Computer Interaction.