School of Economic, Political and Policy Sciences

Graduate Programs in Geospatial Information Sciences

Doctor of Philosophy in Geospatial Information Sciences

75 hours minimum beyond the baccalaureate degree

Faculty

Professors: Carlos L. V. Aiken, Brian J. L. Berry, Denis J. Dean, John F. Ferguson, Daniel A. Griffith, James Murdoch, Fang Qiu, Hsing-Mean (Edwin) Sha, Robert J. Stern, Weili Wu

Associate Professors: Thomas H. Brikowski, Dohyeong Kim, Michael Tiefelsdorf

Assistant Professors: Yongwan Chun, Anthony R. Cummings

Senior Lecturers: Bryan Chastain, Irina Vakulenko

Mission

The mission of the Doctor of Philosophy in Geographic Information Sciences program is to cultivate innovative researchers capable of advancing the frontiers of knowledge in the geospatial information sciences through improved theories, new technologies, innovative methodologies, sophisticated quantitative analyses, and integrative applications. Specifically, program graduates will:

- Demonstrate their knowledge of the fundamental theories and concepts underlying the geospatial sciences.
- Master the advanced methodologies and/or quantitative analyses used in at least one of three geospatial specialization areas: (a) computing and information management, (b) spatial analysis and modeling, or (c) remote sensing and satellite technologies.
- Produce innovative research that advances theory or methodology in the geospatial sciences.
- Participate at academic conferences, publish in peer-reviewed journals, and find employment in research departments of public and private organizations and in major academic institutions.
Objectives

This degree program is jointly offered by the School of Economic, Political and Policy Sciences, the School of Natural Sciences and Mathematics (specifically in the Department of Geosciences) and the Erik Jonsson School of Engineering and Computer Science, and is administered by the School of Economic, Political and Policy Sciences. This unique structure reflects geospatial information science's origins as the confluence of multiple disciplines including geography, computer science, engineering, geology, and various social, policy and applied sciences. It is anticipated that many students will enter the program with a bachelor's or master's degree (and/or work experience) in an application area (such as public administration, geology, or economics) or in a technical specialization (such as engineering, computer science, or statistics). These students may choose to pursue research projects that advance existing geospatial information sciences practices within that application area. Alternatively, students may opt to pursue research that expands the technological or theoretical base of all the geospatial information sciences.

Powerful technologies have emerged in recent years to collect, store, manage, analyze, and communicate information regarding the features of the Earth's surface and to combine these with other types of environmental, social, and economic information. These technologies, which include geographic information systems (GIS), the global positioning system (GPS), and remote sensing, are used in many ways, including the production of digital maps in vehicles, the management and maintenance of city infrastructure, agriculture and forestry, the policing of communities, and the conduct of modern warfare. The PhD in Geospatial Information Sciences aims to develop individuals capable of advancing this field by developing new knowledge or capabilities relevant to it.

Facilities

Students have access to state-of-the-art GIS computing facilities housed in the School of Economic, Political and Policy Sciences and at the NASA Center for Excellence in Remote Sensing in the Department of Geosciences. The university's extensive instructional computing facilities, including those in the Erik Jonsson School of Engineering and Computer Science, are also available. Facilities are open extended hours including evenings and weekends. Enrollment in hands-on courses is controlled to ensure that a computer workstation is available for every student. All major industry-standard GIS and remote sensing software is available. The university is a member of the University Consortium for Geographic Information Science (UCGIS).

Admission Requirements

The university's general admission requirements are discussed on the Graduate Admission page (catalog.utdallas.edu/2014/graduate/admission).

The PhD program in Geospatial Information Sciences seeks applications from students with a baccalaureate, Master of Arts, Master of Science, or professional master’s level degree in any field relevant to geospatial information science including, but not limited to, computer science, economics, engineering, geography, geology, management information systems, marketing, natural resource management, public affairs and public administration, statistics, and urban and regional
planning.

Applicants will be judged and evaluated by the existing admission standards as set forth by the university in its Graduate Catalog and by the standards set forth here by the Geospatial Information Sciences program. A bachelor's degree from an accredited institution or its equivalent and fluency in written and spoken English are required. A grade average of at least 3.25 in undergraduate and graduate course work, and a combined verbal and quantitative score of 300 on the GRE are desirable. An analytical writing score of at least 4.5 in the GRE is considered desirable.

Applicants must submit transcripts from all higher education institutions attended, three letters of recommendation, and an essay outlining their background, education, and academic objectives as they specifically relate to a PhD in Geospatial Information Sciences.

Prerequisites

The following prerequisites/corequisites will also be required for admission to the PhD program: (i) college mathematics through calculus, (ii) competence in at least one modern programming language equivalent to GISC 6317 GIS Programming Fundamentals, and (iii) at least one course in inferential statistics through to regression analysis equivalent to GISC 6301 GIS Data Analysis Fundamentals, EPPS 7313 Descriptive and Inferential Statistics, or GEOS 5306 Data Analysis for Geoscientists. Graduate courses taken at UT Dallas to meet these prerequisites may be counted as electives toward the 75 credit hours required of students entering the PhD program directly from a BA or BS degree, but they shall not be considered substitutes for any other specified course.

Advising

Because of the cross-disciplinary nature of this doctoral program, to ensure adequate preparation and appropriate course sequencing, every doctoral student is required to consult with the student's designated advisor and/or the GIS Doctoral Program Director prior to registration in every semester. Students generally will not have a faculty advisor when they first enter the PhD program, but every student is required to select (with consent of the potential advisor) an advisor from the advising faculty by the end of his/her first academic year.

Degree Requirements

The university's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2014/graduate/policies/policy).

To receive the PhD in Geospatial Information Sciences, students must complete the Geospatial Science Core (15 semester credit hours) to achieve a mastery of appropriate Geospatial Information Science technologies and theory, have Prescribed Specialization Electives (15 semester credit hours), have a Specific Application area or Technical field (12 semester credit hours), evidence research skills through successful completion and defense of a PhD dissertation, and take related electives as necessary for a total of 75 semester credit hours. A maximum of 6 semester credit hours can be taken at the 5000 level and the rest of them should be at the 6000 level or above. In addition, students must satisfy a set of exams and qualifiers. Other courses may be substituted for those
listed below with the written permission in advance of the Director of the GIS Doctoral program.

Geospatial Science Core: 15 hours

Students must earn a minimum grade point average (GPA) of 3.0 across the following five courses:

- **GISC 6381 (GEOS 6381)** Geographic Information Systems Fundamentals
- **GISC 6325 (GEOS 5325)** Remote Sensing Fundamentals
- **GISC 6384 (GEOS 6384)** Advanced Geographic Information Systems
- **GISC 6385 (GEOS 6385)** GIS Theories, Models and Issues
- **GISC 7310** Advanced GIS Data Analysis

Prescribed Specialization Electives: 15 semester credit hours

Students may select any five courses from the following:

I. Geospatial Computing and Information Management

- **CS 6359** Object-Oriented Analysis and Design
- **CS 6360** Database Design
- **CS 6364** Artificial Intelligence
- **CS 6366** Computer Graphics
- **CS 6375** Machine Learning
- **CS 6384** Computer Vision
- **GISC 6317** GIS Programming Fundamentals
- **GISC 6388** Advanced GIS Programming
- **GISC 7363** Internet Mapping and Information Processing
- **MIS 6320** Database Foundations
- **MIS 6324** Business Intelligence Software and Techniques
- **MIS 6360** Agile Software Project Management
- **MIS 6326** Data Management

II. Spatial Analysis and Modeling

- **ECON 6309** Econometrics I
- **ECON 7309** Econometrics II
EPPS 7318 Structural Equation and Multilevel (Hierarchical) Modeling
EPPS 7370 Time Series Analysis
ECON 6316 Spatial Econometrics
GISC 7364 Demographic and Epidemiological Analysis and Modeling
GEOS 5306 Data Analysis for Geoscientists
GISC 6311 Statistics for Geospatial Science
GISC 6331 (CRIM 6322) GIS Applications in Criminology
GISC 6334 (PPPE 6334) Workshop in Environmental and Health GIS/Policy
GISC 6382 (GEOS 6383) Applied Geographic Information Systems
GISC 7360 GIS Pattern Analysis
GISC 7361 Spatial Statistics
EPPS 7313 Descriptive and Inferential Statistics
EPPS 7316 Regression and Multivariate Analysis

III. Remote Sensing and Satellite Technologies

GISC 5322 (GEOS 5322) GPS (Global Positioning System) Surveying Techniques
GISC 5324 (GEOS 5324) 3D Data Capture and Ground Lidar
GISC 5330 (GEOS 5330) Geospatial Applications in Earth Science
GISC 5395 Satellite Geophysics and Applications
GISC 7365 (GEOS 5326) Advanced Remote Sensing
GISC 7366 (GEOS 5329) Applied Remote Sensing
EESC 6360 Digital Signal Processing I
EESC 6363 Digital Image Processing

IV. Customized Geospatial Specialization

Identified by the student with approval in advance by the Director of the GIS Doctoral Program.

Application Area or Technical Field (12 semester credit hours)

Twelve semester-credit hours of specialized course work in an application area or technical field relevant to GIScience. Normally, these will derive from the student's master's degree. These hours may be transferred from another institution, or taken at UT Dallas in an existing master's program.
area and may be applied toward a master's degree in that area.

*Application area* examples: planning, public affairs, criminal justice, health and epidemiology, geoscience, forestry, hydrology, marketing, real estate, economics, civil engineering, etc.

*Technical field* examples: statistics, computer science, software engineering, management information systems, image analysis, operations research/location science, instrumentation.

**Research and Dissertation (variable semester credit hours)**

All students must complete the following class as part of the research and dissertation requirement:

- **GISC 7387** GIS Research Design

In addition, students must complete sufficient additional research and dissertation credit hours to bring the total number of hours they have earned within the UT Dallas doctoral program (or transferred into the UT Dallas doctoral program) to 75 semester credit hours, the minimum required to earn a doctoral degree. Additional research and dissertation hours above and beyond those required to reach the 75 credit hours minimum may be required at the discretion of the student's PhD advisor. Additional research and dissertation hours can be earned through any of the following classes:

- **GISC 6387** Geospatial Sciences Workshop
- **GISC 6389** Geospatial Information Sciences Master's Research
- **EPPS 6310** Research Design I
- **EPPS 6342** Research Design II
- **GISC 8320** Geospatial Sciences Seminar
- **GISC 8V29** Research in GIS
- **GISC 8V99** or **GEOS 8399** or **CS 8V99** Dissertation

**Other Related Electives (0 to 24 semester credit hours)**

Students may choose up to 24 semester credit hours in related electives (from CS, GEOS, GISC, etc.) with consent of their advisor or the GIS Doctoral Program Director.

**Exams and Qualifiers**

**Qualifying Examination**

The GISC PhD Qualifier Examination is administered in May of a full-time doctoral student's first year, following the completion of the first academic year (i.e. fall and spring semester) by the student. This exam comprises of four parts, each based upon one of the following core courses:

- **GISC 6325** Remote Sensing Fundamentals
• **GISC 6384** Advanced Geographic Information Systems
• **GISC 6385** GIS Theories, Models and Issues
• **GISC 7310** Advanced GIS Data Analysis

A student must pass three of the four parts to pass the exam. If a student fails his/her exam, s/he may retake only the parts they failed in the subsequent August. If s/he does not pass a cumulative total of three parts after the August exam date, then s/he fails the Qualifier Examination, and is withdrawn from the GIS doctoral program.

**Defense of Proposal**

After completing the **GISC 7387** GIS Research Design class, doctoral students must successfully present and defend a dissertation proposal through an oral examination, according to uniform guidelines established by the GIS program.

**Grade Point Qualifier**

Doctoral students must have GPAs of at least 3.25, and preferably 3.5, in courses taken at UT Dallas at the time they register for **GISC 7387** GIS Research Design, or they must petition the GIS faculty for an exemption for extenuating circumstances beyond the student's control.

**Defense of Dissertation**

A dissertation must be prepared and defended successfully following the procedures established by the Dean of Graduate Studies.

Note: Individuals experienced with GIS may have the introductory course (**GISC 6381**) waived at the discretion of the Geospatial Information Sciences Program Head, but must take an additional course from the prescribed specialization elective courses listed above.

**Master of Science in Geospatial Information Sciences**

*36 semester credit hours minimum*

**Faculty**

**Professors:** Carlos L. V. Aiken, Brian J. L. Berry, Denis J. Dean, John F. Ferguson, Daniel A. Griffith, James Murdoch, Fang Qiu, Hsing-Mean (Edwin) Sha, Robert J. Stern, Weili Wu

**Associate Professors:** Thomas H. Brikowski, Dohyeong Kim, Michael Tiefelsdorf

**Assistant Professors:** Yongwan Chun, Anthony R. Cummings

**Senior Lecturers:** Bryan Chastain, Irina Vakulenko
Mission

The mission of both tracks of the Master of Science in Geospatial Information Sciences program is to provide students a rigorous understanding of the technologies, quantitative techniques, models and theories used to acquire and manage spatially referenced information, analyze spatial processes, communicate spatial information, and provide spatial decision support. The second track has the additional mission of providing students with a thorough understanding of the scientific research method. UT Dallas graduates will have strong analytical and numerical skills, knowledge of empirical and quantitative research methodologies, and employ novel geographic information sciences technologies. They will use these capabilities to support public and private sector organizations, to address significant societal issues, and to enhance understanding of the human and natural environments. They will successfully compete at the highest level for jobs requiring geospatial skills and for entry into quality doctoral programs in relevant areas. More specifically, graduates of the program will:

- Possess a thorough knowledge of the technologies, quantitative techniques, models and theories used to acquire and manage spatially referenced information and to analyze spatial processes.
- Have strong analytical and numerical skills, knowledge of empirical and quantitative research methodologies, and be able to employ these skills and methodologies in novel geographic information sciences applications.
- Be able to identify and apply appropriate geospatial methodologies to support public and private sector organizations, to address significant societal issues, and to enhance understanding of the human and natural environments.
- Successfully compete at the highest level for jobs requiring geospatial skills and for entry into quality doctoral programs in relevant areas.

Objectives

Students may choose between two tracks within the Master of Science in Geospatial Information Sciences program. Both tracks are offered jointly by the School of Economic, Political and Policy Sciences and the School of Natural Sciences and Mathematics. The first track is a professional program that focuses on the use of Geographic Information Systems (GIS) and associated technologies such as remote sensing and global positioning systems for acquiring, describing, managing, analyzing and communicating spatially-referenced information in order to provide decision support.

This track emphasizes coursework, and involves a GIS Master's Research class where a student needs to identify a faculty member as his/her master's advisor, prepare a proposal for a professional GIS Master's project, and conduct research under the supervision of the advisor. To obtain his/her master's degree, a student must present the master's project to the faculty and fellow students and successfully defend it. Students are expected to master the concepts underlying GIS, the skills for implementing GIS projects in public or private sector organizations, and the ability to use GIS in pure or applied research in substantive areas. Graduates can apply their skills in a variety of areas such as...
public administration and policy analysis; public safety, criminology, emergency preparedness management; environmental and resource management; urban, regional, social service and transportation planning and analysis; marketing, site selection, logistics and real estate; and resource exploration, including petroleum.

The second track of the Master's of Science in Geospatial Information Sciences program is a conventional program that offers a balance between coursework and research. A student needs to register for a Master's Thesis class (GISC 6V98) under a supervising advisor to conduct a research project, which will ultimately lead to a research-oriented master's thesis. To obtain his/her master's degree, a student must present the master's thesis to the faculty and fellow students and successfully defend it. This track is aimed at students who want to hone their research skills, and is the preferred route for students who may want to move to a doctoral program. Graduates in this track can apply their skills to the same areas as graduates from the first track, but also have the option of moving into research-oriented jobs, and maximizing their ability to move into doctoral programs.

Facilities

Classes are offered through state-of-the-art GIS computing facilities housed in the School of Economic, Political and Policy Sciences and the NASA Center for Excellence in Remote Sensing in the Department of Geosciences. The university's extensive instructional computing facilities are also available. Facilities are open extended hours including evenings and weekends. Enrollment in hands-on courses is controlled to ensure that a computer workstation is available for every student. All industry-standard GIS and remote sensing software is available. The university is a member of the University Consortium for Geographic Information Science (UCGIS).

Admissions Requirement

The university's general admission requirements are discussed on the Graduate Admission page (catalog.utdallas.edu/2014/graduate/admission).

For admission to the program, a baccalaureate degree from an accredited university or college is required and Graduate Record Examination (GRE) or Graduate Management Aptitude Test (GMAT) scores must be presented. A 3.0 undergraduate grade point average (on a 4.0 point scale), and a combined verbal and quantitative score of at least 295 on the GRE, or equivalent score on the GMAT, are desirable. Students must also submit transcripts from all higher education institutions attended, three letters of recommendation, and a personal statement, approximately one page in length, outlining their background, education and professional objectives.

Degree Requirements

The university's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2014/graduate/policies/policy).

To earn the Master of Science in Geospatial Information Sciences, students must complete a minimum of 36 semester credit hours of work beyond the prerequisites. Both tracks of the program
involve the core requirement of 15 semester credit hours, and prescribed electives for 18 semester
credit hours. The two tracks differ in their research requirements (3 semester credit hours). Students
must achieve at least a 3.0 grade point average in the core requirement and an overall grade point
average of 3.0 to graduate. Other courses may be substituted for those listed below with the written
permission in advance of the Geospatial Information Sciences Program Head.

Program Core Requirement - Both Tracks: 15 semester credit hours

Students must earn a minimum grade point average (GPA) of 3.0 in the following courses:

- **GISC 6301** GIS Data Analysis Fundamentals
- **GISC 6317** GIS Programming Fundamentals
- **GISC 6325 (GEOS 5325)** Remote Sensing Fundamentals
- **GISC 6381 (GEOS 6381)** Geographic Information Systems Fundamental
- **GISC 6384 (GEOS 6384)** Advanced geographic Information Systems

Prescribed Electives (18 semester credit hours)

- **CS 6359** Object-Oriented Analysis and Design
- **CS 6360** Database Design
- **CS 6366** Computer Graphics
- **CS 6384** Computer Vision
- **GISC 5310 (GEOS 5310)** Hydrogeology
- **GISC 5311 (GEOS 5311)** Applied Groundwater Modeling
- **GISC 5322 (GEOS 5322)** GPS (Global Positioning System) Satellite Surveying Techniques
- **GISC 5324 (GEOS 5324)** 3D Data Capture and Ground Lidar
- **GISC 5330 (GEOS 5330)** Geospatial Applications in Earth Science
- **GISC 5395** Satellite Geophysics and Applications
- **GISC 6331 (CRIM 6332)** GIS Applications in Criminology
- **GISC 6334 (PPPE 6334)** Workshop in Environmental and Health GIS/Policy
- **GISC 6382 (GEOS 6383)** Applied Geographic Information Systems
- **GISC 6385** GIS Theories, Models, and Issues
- **GISC 6387 (GEOS 6387)** Geospatial Sciences Workshop
- **GISC 6388** Advanced GIS Programming
- **GISC 7310** Advanced GIS Data Analysis
Choose one of the following Research Requirement Tracks:

**Research Requirement - Project Track: 3 semester credit hours**

- **GISC 6389** Geospatial Information Sciences Master's Research

AND successfully defend a professional GIS Master’s Project

**Research Requirement - Thesis Track: 3 semester credit hours**

- **GISC 6V98** Master's Thesis

AND successfully defend a GIS Master’s Research Thesis

1. Individuals experienced with GIS may have the introductory course (GISC 6381) waived at the discretion of the Geospatial Information Sciences Program Head, but must take an additional course from the prescribed specialization elective courses listed above.

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