Graduate Tracks

GEOINFORMATION & GEODETIC ENGINEERING

Geoinformation and Geodetic Engineering emerged from the scientific framework of photogrammetry, remote sensing, geodesy, Geo-Information Science (GIS) and digital mapping, as a sub-discipline of the Information Technology (IT). It combines science and engineering of acquisition, modeling, synthesis, analysis, and management of spatially referenced data at macro- and micro-scales. This modern discipline uses land-based, airborne, marine (sub-surface) and satellite-based platforms and sensors to acquire spatial and geolocation data that are integrated to create a geospatial information system together with the accuracy characterization. The field of applications is broad, ranging from mapping, emergency response, change detection and urban planning to environmental and climate monitoring, precision agriculture, intelligent transportation systems, location-based services, intelligence gathering, surveillance, etc. Obtaining advanced degrees in Geoinformation and Geodetic Engineering at OSU will place our graduates into top position in the international job market.

Graduate studies in Geoinformation and Geodetic Engineering—a track in the Civil Engineering graduate program—cover the following disciplines:

- Advanced numerical methods and geostatistics
- Reference systems and frames
- Global Navigation Satellite Systems (GNSS) including GPS and their integration with other navigation technologies
- Light Detection and Ranging (LiDAR), high-resolution imaging, surface extraction, 2D/3D signal processing
- Remote sensing, photogrammetry and computer vision
- Machine learning in remote sensing images analysis
- Geospatial and geographic information systems (GIS)
- Multi-sensor geospatial data acquisition systems
- Modeling, integrating and calibrating of multi-sensor systems
- Mobile mapping technologies
- Geomatics applications in Smart Cities
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Our MS and PhD graduates work for government organizations, such as NASA, USGS, NGS, NOAA, NGA, DOT, as well as in various companies, such as Trimble, Topcon, Hexagon, Fugro, ESRI, Google, Amazon, Apple and Microsoft, who design, manufacture and operate navigation, surveying and mapping systems, including imaging systems and software, geospatial database systems and mapping, remote sensing and data visualization systems, including web-portals.

Applicants with degrees in Geomatics Engineering, Geodetic Science, Civil Engineering, Electrical Engineering, Computer Science and Engineering, Mathematics, Earth Science, Geography, and other relevant disciplines are encouraged to apply. Completion of this graduate track does not guarantee the eligibility of the graduate for professional engineering registration.

Research

Geoinformation and Geodetic Engineering at OSU pursues research through activities in the Satellite Positioning and Inertial Navigation Laboratory (SPIN: http://spinlab.osu.edu), Photogrammetric Computer Vision Laboratory (PCVLab: http://pcvlab.engineering.osu.edu), and Geospatial Data Analytics Laboratory (GDA: http://u.osu.edu/qin.324/).

At SPIN Lab, Profs. Grejner-Brzezinska and Toth and their research team study the state-of-the-art in localization and navigation with GPS and, generally, the Global Navigation Satellite System (GNSS) and their integration with other sensors; personal navigation indoor and outdoor, cooperative navigation for autonomous navigation and collision avoidance, safety and security, modern sensor integration and data fusion, LiDAR, airborne surveying, remote sensing, surface modeling and feature extraction, and other emerging areas, such as hyperspectral imaging, sensor networks, mobile mapping, and Unmanned Airborne Systems (UAS). SPIN Lab is one of the leaders of the Consortium of Ohio Universities on Navigation and Timekeeping (COUNT) http://www.countohio.org/. COUNT expands the expertise and further training of undergraduate and graduate students as well as employees of the US-based navigation industry, and offers annual workshops and short courses providing system-level training of navigation professionals, to share their latest research findings, and to offer early industry exposure to graduating students.

At PCVLab, Prof. Yilmaz and his research group study large scale 3D recovery, 3D Human Action Analysis, Indoor and outdoor navigation, and data visualization for mobile platforms, i.e. smartphones and tablets, 3D object localization and tracking, and 3D scene understanding and object recognition problems. The group considers visual and non-visual sensors and their integration to find solutions to these stated problems using supervised and non-supervised machine learning techniques; and the visualization is governed by augmented and mixed reality using mobile platforms and specialized goggles, such as Microsoft HoloLens and Google Glass.

At GDA Lab, Prof. Qin and his research group study machine learning problems and fundamental geometry-spectrum processing and analysis of remote sensing data, as well as their integration with the Geographic Information System (GIS). Their research deals with data from different satellite, airborne (UAS, airplane) and terrestrial platforms. These data include moderate and high-resolution panchromatic, multispectral, hyperspectral, thermal infrared images with single-view and multi-view, LiDAR and SAR (Synthetic Aperture Radar) data. The group grounds their research on developing innovative imaging data analysis algorithms in solving fundamental and applied problems in geospatial science and engineering, including photogrammetry based high precision mapping, remote sensing image classification, vision-based localization, 3D building modeling, change detection, object retrieval, and spatial-temporal modeling of geospatial data, with applications to digital smart cities, earthquake damage assessment, coastal monitoring, forest monitoring, precision agriculture, landslide detection, planetary mapping.

Prof. Wang's research interests are in studies of Earth and space observations, and interpretation of remote sensing data. He specializes in the analysis and application of various geodetic measurement systems, including high-precision Global Navigation Satellite System (GNSS), satellite and airborne gravimetry (e.g. Gravity Recovery And Climate Experiment), LiDAR, Interferometric synthetic aperture radar (InSAR) etc.. His current research focuses on the integration of multiple types of geodetic measurements and models to understand a variety of geophysical/geodetic processes including crustal deformation of global and regional scales, terrestrial water storage variation, glacier and ice-sheets kinematics, sea level change, earthquake deformation and infrastructure deformation monitoring. He also develops new algorithms aimed at assessing and improving the accuracy of the measurements from GNSS and satellite gravimetry.

Facilities

The Department houses a number of IT facilities, campus wide sensors networks, and various test vehicles available for advanced studies in Geoinformation and Geodetic Engineering. The SPIN Lab is located at 225 and 246 Bolz Hall with conference, study and work areas. The laboratory hosts a number of GPS/GNSS hardware, GPS/inertial integrated navigation systems, indoor RF-based and image-based navigation systems, numerous imaging sensors, UAS, vehicle and pushcart-based mobile mapping systems, etc. The PCVLab is located at 233 Bolz Hall with a 2,000 square feet research space divided into sensor calibration, meeting, study and presentation rooms. The laboratory houses a number of imaging sensors, depth cameras, IMUs, mobile computing platforms, state of workstations connected to OSU computing resources. PCVLab has multiple UAV and UGV platforms with imaging capabilities. The GDA lab is located at 417 Bolz Hall with space for meeting, research, and work. It hosts a stereo measurement workstation for high precision measurement and various high-end computers. GDA Lab has its in-house developed high-performance satellite/aerial photogrammetric processing software systems capable of computing city scale ground topography.

The research laboratories have access to the Ohio Supercomputing Center (OSC) which is equipped with a 16-processor Cray SV1 with a central memory of 25 Gbtyes, a 128-processor Cray T3E with 300 MHz Alpha processors, a Cray T94 with 4-processors, and a 12-processor Cray J-90 support a mass storage system. The SV1 supercomputer has a peak performance of approximately 19.2 Gflops.

The Department houses software for image processing (ERDAS Imagine, PCI Geomatics, ENVI, ER Mapper, IDL), geographic information systems (ESRI ArcGIS), and GPS data processing (Trimble and Leica Geomatics Office). The Department maintains specialized computational facilities under the auspices of the College of Engineering Region 1. The physical facility consists of three labs with over 135 PCs and multiple printers. Students have 24-hour, 7-days-a-week keycard access. Some are available on a walk-in basis; others provide studio settings for advanced users. At least 50 software packages are available, including the Microsoft Office suite, AutoCAD, various GIS and image processing packages. The University also provides and environment that gives students access to a variety of computer resources on campus, in Ohio, and on the Internet.

Faculty

Dorota Grejner-Brzezinska, Professor, PhD, The Ohio State University (positioning and navigation with GPS and multi-sensor systems, integrated systems for assured navigation, personal and indoor navigation, advanced numerical methods, mobile mapping)
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Rongjun Qin, Assistant Professor, PhD, ETH Zurich, Switzerland (remote sensing data analytics, photogrammetry, machine learning, information retrieval from multi-dimensional geospatial data, smart cities and urban sustainability)
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Lei Wang, Assistant Professor, PhD, The Ohio State University (geodesy, high-precision GNSS for static and kinematic positioning, satellite gravimetry, data analytics, data integration for spatiotemporal modeling, earthquake modeling)
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Academic Program

Master of Science (MS) Program. Two types of MS options are offered: thesis and non-thesis. The thesis option requires 30 graduate credit hours, including 6 credit hours for research and thesis. The non-thesis option requires 33 graduate credit hours. A minimum of 6 credit hours of coursework to develop in-depth knowledge in Geoinformation and Geodetic Engineering is to be selected from the current Graduate Committee-approved Table A listing. A minimum of 6 credit hours of coursework to develop breadth in Geoinformation and Geodetic Engineering is to be selected from Table B. At least 3 credit hours of mathematics are also required.

Doctoral Degree (PhD) Program. The PhD degree requires 80 graduate credit hours, including 30 credit hours for research and dissertation. A minimum of 12 credit hours of Geoinformation and Geodetic Engineering coursework (Table A) is required. An additional 8 credit hours of courses from Table B are also required.

Funding

Funding is available to support graduate education through Graduate Research Assistantships (GRAs), Graduate Teaching Assistantships (GTAs), University and Department Fellowships, and other sources. Prospective students are encouraged to contact the faculty in their area of interest to inquire about funding opportunities.

Course Offerings

The Geoinformation and Geodetic Engineering offers two specializations for graduate education: 1) Navigation, and 2) Photogrammetric Computer Vision.

Both tracks require the following core courses: CIVILEN 5441 Introduction to GPS: theory and applications; CIVILEN 6451: Introduction to photogrammetry, CIVILEN 5461 Geospatial Numerical Analysis.

The Navigation track requires the following courses: GEODSCI 5652 Adjustment Computations and GEOSCIM 5660 Geometric Reference Systems. The courses suggested for this track are: CIVILEN 8443 Advanced topics in GPS, GEOSCIM 7745 Inertial Navigation/Positioning Analysis, GEOSCIM 7763 Advanced Adjustment Computations.
The Photogrammetric Computer Vision specialization requires CE 8454 Videogrammetry, CSE 5523 Machine Learning and Statistical Pattern Recognition, CSE 5524 Computer Vision for Human-Computer Interaction, GEODSCI 5652 Adjustment Computations. The courses suggested for this track are: GEODSCI 7745: Inertial Navigation/Positioning Analysis, STAT 6450: Applied Regression Analysis, STAT 6540: Applied Stochastic Processes, STAT 6570: Applied Bayesian Analysis, ECE 7866: Computer Vision and Multisensor Integration.

The required credit hour balance should be selected from the tables A and B below; other supplemental courses are also offered in Electrical and Computer Engineering, Computer Science and Engineering, Environment and Natural Resources, Geodetic Science, Geography, Mathematics and Statistics and can be accepted in lieu of the Table A and B courses upon the approval from the academic adviser and the Graduate studies Committee.

TABLE A	Title	Credits
CIVILEN 5001	Introduction to Geographic Information Systems	4
CIVILEN 5420	Remote Sensing of Environment	3
CIVILEN 5421	Spatial Analysis Techniques for Civil Engineering	3
CIVILEN 5441	Introduction to GPS: theory and applications	3

CIVILEN 5461	Geospatial Numerical Analysis	4
CIVILEN 6431	GIS and Cartographic Engineering	4
CIVILEN 6451	Introduction to photogrammetry	4
CIVILEN 7432	Advanced spatial data structures and databases	4
CIVILEN 7433	GIS Analysis and projects	3
CIVILEN 7442	Fundamentals of GPS and Reference Systems	4
CIVILEN 7452	Spatial Geometry and Spectral Analysis	4
CIVILEN 7453	Photogrammetric computer vision	3
CIVILEN 7461	Advanced geospatial numerical analysis	3
CIVILEN 8420	Radiometric measurements and modeling	3
CIVILEN 8421	Integrating Remote Sensing with Engineering Databases	3
CIVILEN 8434	Advanced planetary mapping and exploration	3
CIVILEN 8443	Advanced topics in GPS	3
CIVILEN 8454	Videogrammetry	3
CIVILEN 8462	Advanced geospatial sensors and methods	3
GEOSCIM 5637	Topics in Mapping	3
GEOSCIM 5652	Adjustment Computations	5
GEOSCIM 6786	Geospatial Data Structures for Computer Mapping and GIS	3
GEOSCIM 7745	Inertial Navigation/Positioning Analysis	4
GEOSCIM 7765	Analysis and Design of Geodetic Networks	2
GEOSCIM 8871	Advanced Physical Geodesy	3
GEOSCIM 8873	Advanced Satellite Geodesy	3
Table B		
CSE 5523	Machine Learning and Statistical Pattern Recognition	3
CSE 5524	Computer Vision for Human-Computer Interaction	3
EARTHSC 5642	Geomathematical Analysis	3
ECE 5460	Image Processing	3
ECE 6001	Probability and Random Variables	3
ECE 7001	Stochastic Processes, Detection, and Estimation	3
ECE 7866	Computer Vision and Multisensor Integration	3
GEOSCIM 5660	Geometric Reference Systems	4
GEOSCIM 6776	Physical Geodesy	4
GEOSCIM 7763	Advanced Adjustment Computations	4
GEOSCIM 8862	Adjustment Computations for Random Processes	2
MATH 4568	Linear Algebra for Engineering Graduate Students	3
MATH 4578	Discrete Mathematical Models	4
MATH 5601	Essentials of Numerical Methods	3
MATH 5602	Computational Partial Differential Equations	3
MATH 5603	Numerical Linear Algebra	3
MATH 6601	Numerical Methods in Scientific Computing I	4
MATH 6602	Numerical Methods in Scientific Computing II	4

STAT 6450	Applied Regression Analysis	4
STAT 6540	Applied Stochastic Processes	3
STAT 6550	Statistical Analysis of Time Series	2
STAT 6560	Applied Multivariate Analysis	3
STAT 6570	Applied Bayesian Analysis	2
STAT 6950	Applied Statistics II	4

Graduate Applications: To be considered for admission, you must first apply to the University. Applications are available at http://gpadmissions.osu.edu/apply/grad.html. For additional information, contact Mary Leist, leist.48@osu.edu, 614/ 292-2005.