Geomatics Engineering at Ryerson University: A Success Story

By Ahmed Shaker, Mike Chapman, Ahmed El-Rabbany and Songnian Li

Ryerson University is a leading academic institution in Ontario offering Geomatics and Surveying education. The university responded to the early call of the Association of Ontario Land Surveyors (AOLS) to establish a superior program in Survey Engineering at the advanced technology level. Starting in 1966 and continuing to 1995, Ryerson responded with a four-year program, which offered a Bachelor of Technology degree, and a three-year diploma program. The Department of Civil Engineering at Ryerson University now offers a Bachelor of Engineering (B. Eng.) degree in Civil Engineering with a Geomatics Engineering option, which is unique in Canada for training students with combined skills in Civil and Geomatics Engineering.
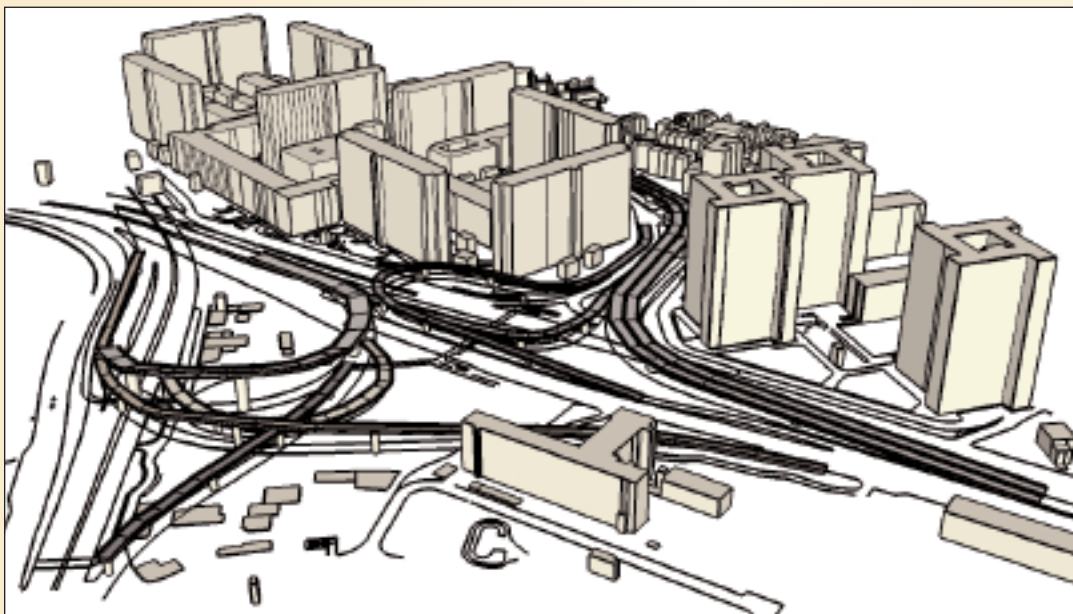
The Geomatics Engineering option focuses on different Geomatics Engineering areas including geospatial data management systems, satellite positioning, digital image processing and mapping, remote sensing, photogrammetry, and geographical information systems. Courses specific to the Geomatics Engineering option are covered in the final year of the curriculum. All other essential components of the discipline of Civil Engineering are completed in the first three years, including highway design, environmental science for engineers, structural design, water resources engineering, management, geotechnical engineering, and foundation design.

The curriculum of the Civil Engineering – Geomatics Engineering option is unique in Ontario and Canada and provides a solid background in Civil Engineering subjects and specialization in Geomatics Engineering. The program is accredited by the Canadian Engineering Accreditation Board (CEAB). The graduates of the program are eligible for certification by the Professional Engineers of Ontario (PEO) as Professional Engineers (P. Eng.) and by the Association of Ontario Land Surveyors (AOLS) as Ontario Land Surveyors (O.L.S.) and Ontario Land Information Professionals (O.L.I.P.).

Amongst the twenty full-time faculty members, there are four full-time professors who are teaching and conducting research in all areas of Geomatics Engineering: Prof. Ahmed El-Rabbany (Graduate Program Director) specializes in satellite navigation and geodesy, Prof. Mike Chapman specializes in photogrammetry, deformation monitoring and mobile mapping, Dr. Songnian Li specializes in spatial information management and GIS systems, and Dr. Ahmed Shaker specializes in satellite remote sensing and airborne LiDAR.

As one of the top choices within the universities in Ontario, the Geomatics Engineering courses offered at Ryerson focus on both theory and practical training so that undergraduate students are career-ready upon graduation. The Civil Engineering department provides state-of-the-art hardware and software for Geomatics Engineering students. There are two computer labs for undergraduate and graduate Geomatics Engineering students which are equipped with the latest hardware and software. For the final year of the undergraduate program, students are encouraged to work on research-based theses or Capstone Design Projects which are in collaboration with industrial partners in order to deal with real-world Geomatics Engineering problems.

The Department of Civil Engineering at Ryerson University also offers a graduate stream in Geomatics

3D Digital Model of an intersection in Hong Kong extracted from stereo IKONOS satellite images.

Engineering including a Master of Engineering (M.Eng.), a Master of Applied Science (M.A.Sc.), and a Doctor of Philosophy (Ph.D.) to domestic and international students. Currently, there are more than fifteen graduate students studying in the Geomatics Engineering stream in all levels. Graduate students are supported with scholarships funded by the Natural Sciences and Engineering Research Council (NSERC), the Ontario Graduate Scholarship (OGS), the GEOIDE Network of Centres of Excellence, the Egyptian Government, the Association of Ontario Land Surveyors (AOLS) Educational Foundation, the Canadian Institute of Geomatics (CIG) and the Canadian Remote Sensing Society (CRSS), in additional to the internal scholarships offered by the university.

With the benefit of a comprehensive education and hands-on training, students excel in many peer competitions at national and regional levels. Recent examples of successful competitions are: the 2nd prize for the undergraduate student paper competition in the 2008 Canadian Society for Civil Engineering, the 1st prize of the student paper presentation competition (undergraduate category) of the Institute of Transportation Engineers Toronto/Hamilton/Southwest Ontario Section in 2009, the 3rd prize, the 1st and 2nd prizes and the 1st, 2nd and 4th prizes for the 2007, 2009 and 2010 AOLS graduate student poster competitions, respectively.

Both theoretical and application research is carried out in order to contribute to the development of advanced technologies and for technology transfer to industry. Theoretical research is conducted in global navigation satellite system (GNSS), precise point positioning, multibeam echo-sounding surveys, integration of GNSS and micro-electro-mechanical system (MEMS)-based inertial navigation system (INS), geometric and radiometric modeling of airborne laser scanning data, high resolution satellite sensor modeling, design and development of feature extraction and pattern recognition systems, high-precision deformation modeling, mobile mapping systems, three dimensional infrastructure management, architectural design for collaborative spatial decision support systems, 3D GIS, and open source GIS.

In the area of application-based research, a number of active projects are applying Geomatics Engineering in environmental, structural and transportation engineering applications. In the environmental area, multi-temporal satellite images are used for landfill site monitoring. Another project is concerned with the environmental impact of landfill sites on the surrounding environment, which is assessed and evaluated using satellite imagery. One application involves the development of different techniques from satellite imagery for data extraction to be used as tools for

Data Collection by GPS Field survey in Toronto. Dr. Ahmed Shaker (on the left) and Mohamed Elsobie (PhD student).

the development of small scale urban rainfall runoff.

Remote sensing techniques have been used in transportation engineering applications since the 1970s. Current research work at Ryerson focuses on the use of state-of-the-art high-resolution stereo satellite images to extract 3D highway alignments, highway geometric design parameters, and to develop 3D digital surface models along the highways for 3D visualization, road safety and car simulation applications. It is found that the highway alignments retrieved from the stereo IKONOS images result in accuracies of less than 1-m in both the horizontal and the vertical directions. With the competitive metre-level accuracy, stereo satellite images are also used for landslide monitoring, detection and prediction (one of the most destructive problems to many urban/sub-urban areas). Several other research projects are ongoing in the Civil Engineering Department. Integration between Transportation Engineering, GPS and GIS in intelligent transportation systems is one of the current active research streams.

Geomatics Engineering is a demanding engineering discipline and one of the fastest growing fields not only in North America but across the globe. Industry surveys indicate that students who are pursuing the Geomatics discipline are finding that the salaries which are being offered are competitive when compared to other engineering disciplines. The long term plan of the Civil Engineering Department is to further support and strengthen teaching, research and training of highly qualified personnel in Geomatics Engineering.

Professors Ahmed Shaker, Mike Chapman, Ahmed El-Rabbany and Songnian Li can be reached by email at (ahmed.shaker, mchapman, rabbany, snli)@ryerson.ca.