GPS and LIDAR Education at the University of Houston

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Nov. 17, 2014
Outline

• Department of Earth and Atmospheric Sciences at UH
• Current GPS and LIDAR Courses at UH
• Summer Geophysics Field Camp
• Challenges
The University of Houston, TX

- The **University of Houston (UH)** is a state research university and the flagship institution of the **University of Houston System**.

- Founded in 1927, UH is Texas's third-largest university with nearly **41,000 students**.

- The Carnegie Foundation classifies UH as a **Tier One Research University**.

- The University of Houston has been designated an **Hispanic-Serving Institution (HSI)** by the U.S. Department of Education Office of Postsecondary Education (2012).
### Table 7: Fall semester enrollment statistics for the BS, MS and PhD programs, 2009 – 2013.
Data from UH Statistical Handbook.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
<th>Fall 2012</th>
<th>Fall 2013</th>
<th>Fall 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>143</td>
<td>184</td>
<td>237</td>
<td>246</td>
<td>184</td>
<td>150</td>
</tr>
<tr>
<td>Doctoral</td>
<td>49</td>
<td>56</td>
<td>69</td>
<td>78</td>
<td>99</td>
<td>109</td>
</tr>
<tr>
<td>Total Graduate</td>
<td>192</td>
<td>240</td>
<td>306</td>
<td>324</td>
<td>283</td>
<td>259</td>
</tr>
<tr>
<td>Total Undergraduate</td>
<td>256</td>
<td>331</td>
<td>413</td>
<td>408</td>
<td>434</td>
<td>457</td>
</tr>
<tr>
<td>Total Number of EAS Students</td>
<td>448</td>
<td>571</td>
<td>719</td>
<td>732</td>
<td>717</td>
<td>716</td>
</tr>
</tbody>
</table>

### Table 15: Total number of tenured/tenure track faculty in EAS, YF2010-2015.

<table>
<thead>
<tr>
<th>Fiscal Year (FY)</th>
<th>FY10</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Faculty</td>
<td>25</td>
<td>27</td>
<td>27</td>
<td>28</td>
<td>30</td>
<td>33</td>
</tr>
</tbody>
</table>

The largest geoscience department in North America!
GPS&LIDAR Education at the University of Puerto Rico-Mayaguez (2006-2011)

Unavco, Inc.

- Geoscience Applications of GPS (Undergraduate level)
- Natural Hazards (Undergraduate/graduate)

Kinematics of the Cerca del Cielo, Puerto Rico landslide derived from GPS observations

Teaching Through Research

Guo-Quan Wang

Supported by UNAVCO GPS equipment loan program!
TLS Scanning

Supported by UNAVCO LIDAR team!
Dr. David Phillips

Delineating and defining the boundaries of an active landslide in the rainforest of Puerto Rico using a combination of airborne and terrestrial LIDAR data

Guoquan Wang, James Joyce, David Phillips, Ramesh Shrestha & William Carter

Teaching Through Research

Landslides
Journal of the International Consortium on Landslides
ISSN 1612-510X
Volume 10
Number 4
Landslides (2013) 10:503-513
DOI 10.1007/s10346-013-0400-x
GPS & LIDAR Courses at UH
New Course Development

• GEOL 4332/6323 - Geoscience Applications of GPS and LIDAR
  (Undergraduate and graduate combined, elective)
  Enrollment: 2013 Spring—25 students; 2014 spring 45 students; 2015-Spring > 55 students

• GEOL 6324 - Satellite Positioning and GPS Geodesy
  (Graduate level, elective)

Fundamental of GPS Geodesy, field instrumentation, data collection, process, applications
GPS education: Do Science!

Field Instrumentation and Education!
Teaching High-Accuracy Global Positioning System to Undergraduates Using Online Processing Services

Guoquan Wang

ABSTRACT
High-accuracy Global Positioning System (GPS) has become an important geoscientific tool used to measure ground motions associated with plate movements, glacial movements, volcanoes, active faults, landslides, subsidence, slow earthquake events, as well as large earthquakes. Complex calculations are required in order to achieve high-precision positions and thereby high-accuracy displacement measurements. It is difficult to familiarize undergraduates with the complex data processing within a period of one semester. Several national organizations offer free online GPS processing services. Using these online services, a GPS beginner can bypass the complex aspect of data processing and focus on applications of the high-accuracy GPS technology. This paper introduces the author’s experience using Online Positioning User Service, provided by the National Geodetic Survey (NGS) and Automatic Precise Positioning Service, provided by the Jet Propulsion Laboratory (JPL) in teaching two undergraduate courses, Applications of GPS in Geosciences and Geological Hazards, at the University of Puerto Rico at Mayaguez. Two class projects, “Where is My House?” and “GPS Landslide Monitoring,” were designed to practice GPS data collection, processing, and analysis. The enrollments of the two courses were about 10 senior undergraduate students. Online GPS data processing helped both the instructor and students in teaching and learning the intricacies of GPS data processing, understanding different reference frames and coordinate systems, and familiarizing local permanent reference stations. Students who had taken the GPS classes often help professors in the geology department and other departments to survey field sites with centimeter-level accuracy. © 2013 National Association of Geoscience Teachers. [DOI: 10.5408/12-295.1]
GPS & LIDAR Courses at UH
Exist Course Improvement

• **GEOL 4330 Introduction to Geophysics**
  A requirement course for all Geology and Geophysics majors (enrollment >100)
  Earthquake seismology, exploration seismology, gravity, geomagnetism, electromagnetism, borehole, well log, GPS & LIDAR
  Enrollment: 106 (2012), 97 (2014)
  GPS & LIDAR: GPS-1.5 Hour, LIDAR-1.5 Hour, a one-day field trip, 1/10 of the total course

• **GEOL 4355 - Geophysical Field Camp**
  GPS and LIDAR, 2 of 8 days (Enrollments: 32-35 students, 2012, 2013, 2014)
Main Topic: Move a Giant Rock into your Lab/Computer!

UH Geophysics Field Camp (2012)

YBRA, Montana

Mr. Cristopher Crosby
Main Topic: Move a Giant Rock into your Lab/Computer!

Science topic: Coastal Erosion!

Mr. Ken Austin
Challenges for Integrating GPS & LIDAR into Geoscience Curriculum/Education

(1) How to integrate GPS & LIDAR into other geoscience courses?

*Physical Geology*, Earthquake, Global Tectonics, Natural Hazards

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**Figure 4.** Proportional enrollments in Core Natural Science courses for non-science majors, by department, fall 2014.
Challenges for Integrating GPS & LIDAR into Geoscience Curriculum/Education

(2) How to integrate GPS&LIDAR into pre-college (K-12) science education?

HoustonNET (40 +20 GPS stations)

30 stations are installed in public school campus!
Challenges for Integrating GPS & LIDAR into Geoscience Curriculum/Education

(3) How to get LIDAR and GPS equipment for field education?

Puerto Rico and Virgin Islands GPS Network

HoustonNET (40 +20 GPS stations)

New GPS station at YBRA (GPS+Seismic Station)
Challenges for Integrating GPS & LIDAR into Geoscience Curriculum/Education

(4) Faculty expertise development

**NSF TUES** (Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics): Integrating GPS and LIDAR into geosciences education (October 1, 2013—September 30, 2016).

**PI: Guoquan Wang**

Faculty Expertise Development Workshop, 3-day workshop, 2016 Spring
Thanks UNAVCO and NSF for your support!
GPS Field Instrumentation
The Crew of UPRM TLS Field Team

2009-2010
Discussion

• When did you start to learn GPS?
• How did you learn GPS?
• Do you teach GPS in your courses?
• How much do you teach?