GEOL 804: Point Clouds and You – Course Description

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Point clouds form an essential data format that will only increase in importance as data collection system become increasingly abundant. Industries, ranging from agriculture to video games, are now leveraging remote sensing technologies to capture high-resolution point clouds to facilitate analyses and generate digital assets. In this module, a working background on LiDAR and photogrammetry is provided with detailed hands-on examples.

This is a new course and we are using the flexible course number 804. If you already have an 804, you can register as 805. If you already have 805 too, contact us.

This is a 1.5 credit course, so HALF of a regular grad course.

Course Cap: 12 students

Prerequisites
While this course has no prerequisites, students with a module or course completed in GIS will find the material less challenging. Please contact us if you don’t have any familiarity and we’ll provide some additional information on what you would need to know and how you might learn it.

This course involves a significant amount of work on, and understanding of, computers. If you are not computer literate at all this course is probably not for you.

We assume no background in LiDAR or Photogrammetry – that’s exactly what we’re providing.

Course Location and Length
The course will be delivered using a mix of online and in person methods unless the health care situation forces us online. If we are online for the entire course, please note that you will have access to computers for processing data remotely but it won’t be ideal. If we are mixed, we will do the hands-on exercise in the Rose Lab, Department of Geological Sciences, observing physical distancing. If numbers are sufficient, we will use the much larger ESIL facility.

Our plan is to have the course consist of some recorded lectures, some online sessions that mix discussions and short lectures and demonstrations, and (if possible) in person hands-on sessions.

The course is expected to run through Weeks 7 – 12 of the Fall 21’ Semester.

Tentative Outline

Foundations
• Review of Computing principles (50 min recorded, 25 minute discussion)
• Review of Geospatial principles (50 min recorded, 25 minute discussion)
• ‘Micro’ Lab session – tour of your computer

Fundamentals of Topographic Data Capture
• Introduction to Point Clouds (15 minute recorded, 10 minute discussion)
• Overview of Photogrammetry (15 minute recorded, 10 minute discussion)
• Overview of LiDAR (15 minute recorded, 10 minute discussion)
• Visualization of Point Clouds, difference between P and L. (15 minute demo)
• Data formats and input/output (10 minute recorded, 5 minute discussion)
• Lab session 1 – hands on with the devices, data capture, loading, simple visualization (3 hours)

*Point Cloud Processing 1*
• Point Cloud Operations with Geological Context (40 minute recorded, 15 minute discussion)
• Overview of hardware and software for processing (10 minute recorded, 5 minute discussion)
• Point Cloud Rasterization (10 minute recorded, 15 minute discussion)
• Point Cloud Processing, Rendering/Visualization, and Map Making (Lab 3 hours)

*Point Cloud Processing 2*
• Orthophoto Generation (10 minute recorded, 10 minute discussion)
• Overview of topology, surfaces, and comp geometry (15 minute recorded, 10 minute discussion)
• From Point Cloud to Mesh – a focus on filtering (25 minute recorded, 15 minute discussion)
• Lab session 2 – Meshing, Orthos, Computational Geometry (3 hours)

*Project Work*
A small project (~10 hours) using open-source or provided data will be a primary deliverable for the module.

• **Goals:**
  o To become familiar with open point cloud data repositories
  o To apply methods used in the course on a new dataset

• **Description:**
  o Find a new dataset in an open-source repository. Some examples include:
    ▪ OpenTopography
    ▪ RockBench
    ▪ Open Heritage 3D
    ▪ Canadian Planetary Emulation Terrain 3D Mapping Dataset
  o The dataset does not need to be limited to geological problems. Provide a full description of the dataset. For example, where and when it was collected, what equipment was used, number and density of points and a description of the terrain covered.
  o Use one analysis method presented in the course and apply it to the dataset you found.

• **Deliverables:**
  o A short 5-min presentation on the project to the group.
  o Present the work in a 5-page conference style paper. This can take the format of: Introduction, site description, data, methods, results, discussion and conclusions.
  o Please include figures and format citations according to Canadian Geotechnical Journal guidelines.
  o Submit any codes used or developed as an appendix.