



## **TLS use in geology field camp**

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### **Summary**

Field camps offer an excellent opportunity for geoscience students to gain field geophysics research skills. Indiana University Geologic Field Station and UNAVCO ([www.unavco.org](http://www.unavco.org); a university-governed consortium that supports geodesy research and learning) teamed up\* to develop a four-day module for a geoscience field camp in which students learn to conduct a terrestrial laser scanner (TLS) survey to address real field research questions. In the course of the module students move from learning the basics of equipment set up and survey design to being able to apply the TLS technique to geoscience field investigations.

\*With support from NSF

### **Context**

#### Audience

Upper level geoscience majors attending a field camp program. The module works well for student groups up to 20 in size with an instructor, TLS technician, and teaching assistant/s.

#### Skills and concepts that students must have mastered

Students have experience making field observations and sketch maps. They must be able to use and apply trigonometry and other basic calculation skills.

#### How the activity is situated in the course

The four-day module is done mid-way through the six-week field camp after the students already have some field experience. A shorter version (1-2 days) could be done as part of a field trip for a major's course such as structural geology or geomorphology.

### **Goals**

#### Content/concepts goals for this activity

Students are able to design and carry out a TLS survey.

#### Higher order thinking skills goals for this activity

Students are able to evaluate the efficacy of using the TLS technique to address different geoscience research questions.

#### Other goals for this activity

The activity gives the students an opportunity to apply basic quantitative skills (such as trigonometry) to field research applications.

### **Activity Description and Teaching Materials**

The four days of the module are broken as follows:

(More detailed example schedule can be found in the TLS Field Camp Manual)

- Day 1. Classroom overview of TLS functionality. Practice time with the scanner and associated equipment components.

Day 2. Simple TLS survey at a relatively small site (~100-200 meters horizontal). Ideally one that is familiar to the students from earlier field camp exercise.

Day 3. Somewhat more complex survey site. Ideally one that addresses a real geoscience research question.

Day 4. Assessment. The students are asked to design and carry out a survey for a defined region (we use part of the Indiana Field Station base camp site).

Supporting materials:

- PowerPoint presentation  
*Gives background and basic information about TLS*
- TLS Field Camp Manual  
*Includes: module schedule, TLS functions, considerations for survey design, survey design worksheets, and scanner specs*
- Example assignment  
*This survey had students investigating degraded fault scarps to estimate earthquake reoccurrence intervals. This was one of the “Day 3” type assignments. Background on the theory and calculations behind this method are given in the “Characterization of Fault Slip and Fault Scarp Erosion” section of the Manual.*
- Equipment list  
*Basic equipment included in a TLS survey*
- Basic workflow procedure  
*Typical sequence of steps in setting up and carrying out a survey*
- Examples of student work  
*Find here examples: 1) from the fault scarp assignment of student write-up and associated spreadsheet; 2) procedure and equipment lists*

## **Teaching Notes and Tips**

### Keeping students occupied

At the outset of a given survey, we carried out a whole-group discussion of where the instruments would be best placed for maximum coverage of the coverage and wide visibility for the reflectors. Different groups were then dispatched to set up different components of the equipment (i.e. the reflectors, scanner, GPS).

One of the challenges of doing a TLS survey with more than a couple people is making sure that students stay engaged and mentally challenged even while they are waiting for their instrument time. We typically broke the students into teams of 3-4. Each team was responsible for running one of the surveys and providing the data for the group. While they wait for their turn with the scanner, there are a series of possible tasks that we give the others to do that help them better understand the components of survey design and parameter calculation AND keep them occupied. These include:

- Completing the Scan Resolution Parameter Worksheet (see final pages in TLS Field Camp Manual) for all the scan positions (not just the one they will be running)
- Compile a list of equipment needed for TLS (example above)
- Compile a standard operating procedures list (example above)

- Traditional observations and measurements – strike/dip, rock type, sketch map of whole feature (what you would be doing at the site if you did not have TLS)
- Observations that would inform TLS analysis later such as:
  - Presence of water
  - Surface texture and color and condition (for intensity measurements) – for example you can show them a Reigl spec sheet on reflectance which ranges from (0) to white concrete (100%) and get them to draw a sketch with reflectance considered
- Have them start on the components of the final write-up that they can do already. For example, The purpose of using TLS in general and the objectives of the particular study

*Ideas for geoscience topics that can addressed in a field camp TLS module*

- Fault scarp diffusion and earthquake reoccurrence intervals
- Terrace vs. scarp analysis
- Lithologic differences (often show up in intensity data)
- Erosion studies repeated annually (ex. post-fire, landslides, slow creep, head scarps, river cut-banks, arroyo formation)

*Other tips*

- TLS requires A LOT of equipment. Choose sites with relatively easy access (especially for the first survey).
- Be sure to visit the site prior to taking students there to survey
- It is helpful to have several range finders (~\$250 for one that does 1000 m). That way more teams can be filling out Scan Resolution Parameter worksheets at the same time.
- At a minimum you need to have several compatible student laptops onto which the software can be loaded (before starting the TLS module). It is more ideal to have access to a computer lab of common-type computers.
- Students need some time to process and analyze the data so the surveys should only be a long half-day at maximum, allowing the afternoon and evening for processing and analyzing.

**Assessments**

The final day of the four-day module is devoted to assessing student learning. In the morning students are given a specific site and asked to design a survey for it. We usually use a portion of the field station main grounds or buildings. They have an hour or so to design their survey set and then present to the whole group their proposal. The group decides on the proposal or amalgamated proposals that are the best. They then set up and carry out that survey.

**Resources**