High-Precision Positioning, Unit 2
Introduction to Kinematic Surveys

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This assignment assesses student ability to plan, execute, and assess positions from a simple kinematic GNSS survey in preparation for more detailed activities in Unit 2.1 and/or Unit 2.2. Refer to the Kinematic GPS/GNSS Survey Methods Manual for guidance, which should be reviewed before starting. Again, the purpose of this assignment is to familiarize yourself with the process so you can do this alone in the future, so take notes and ask questions.

Note: The items handed-in and graded are listed on page 3.

Overview

After an introduction to a field site, students discuss and conceive a science question that can be addressed using a RTK survey. Students then design and execute the survey, post process the data, answer the science question and discuss how the survey could be improved.

Preparing for the Survey

Time spent planning and preparing for a survey will dramatically decrease time and energy spent in the field. It is important that a clear plan for the survey be established and that all members of the team understand the plan and equipment operation before going into the field. Some aspects of the survey may need to be adjusted as field conditions change, but having a basic plan beforehand will make this process easier.

1. Site Selection and Survey Plan

Your instructor will give you a site and discuss how various elements of survey design can improve or degrade the quality of the survey. This may include a few challenges such as line of sight, multi-path errors, limited sky, etc.

- Decide what your objective is.
  - What do you want to produce? A cross-section? A perimeter? Keep it simple.
  - How many survey measurements will it require?
- If available, review a map of the area and discuss decisions about how the survey will be set up. Visualize this plan by sketching a quick field map with the essential elements of the survey: the topography, the survey objective, the base station location.

Take 2–3 minutes to break into pairs and come up with one or two obstacles this site may have and how they can be avoided. What will be their impact on survey accuracy? After, come back as a group and quickly share and discuss your findings.

2. Logistics

Review the Kinematic Methods Manual, Section 3.2, Preparation and Logistics. Account for the logistical and equipment needs of the survey and use the equipment list to keep track of parts.

Executing the Survey

Follow the Methods Manual, section 4, RTK/PPK Setup, as your instructor talks you through an practice survey. Make sure you actively participate in the physical setup and take notes as needed. Ask questions. Create an equipment list that describes everything you are using. Begin by assembling and starting the base station and then assemble and start the rovers.

After base and rover setup is complete, begin recording points to support your survey objective. Pay attention to the precision as you move under and around obstacles. Precision is often listed as the PDOP (Position Dilution of Precision), or as separate HDOP (Horizontal) and VDOP (Vertical) components. Typically, a value less than 4 is adequate, with ~2 being ideal.

When complete, make sure that files are saved and then pack up the equipment. Use an equipment list to make sure all equipment is returned.

Processing Data

Data should be retrieved from the hardware and backed up as soon as possible. Downloading and completing a quick visualization of the data on a field laptop can be a great step for ensuring success in fully processing the data later.

If you set up over a known point, your rover data are already maximum quality and require no processing. Simply export the data and use it for your intended purpose.

If you set up over an unknown point, you have to process the base station data to get a precise position that will then be used to adjust all your rover data. Remember, it may take a day or two to get a quality base station position from OPUS if you set up over an unknown point. Your instructor should provide you with a pre-processed solution if this is the case. Work in groups or as a class to process the data through OPUS. Follow Section 5.3 in the Methods Manual, Data Processing, for OPUS base station solutions. Once you have a solution or position for the base station, process the baselines to correct the rover's positions. Export the corrected data and use it for your intended purpose.

Mapping Points

After the GNSS point data has been processed and corrected for the accurate base station location, load the points into a mapping program or spreadsheet. Prepare a map or cross section of the study site with the base station and rover positions and basic symbols for a couple of other features (roads, trails, buildings, or obstacles), and a legend.

Reflection

Answer the following questions regarding your survey.

- What was the intention of your survey and what did you hope to resolve/measure/map? Justify your survey design.
- Given the data you collected, what was the answer to your science question?
- How well did the resulting positions describe the object(s) you were trying to measure?
- What issues or troubleshooting occurred in the field and how were they resolved?
- How did the point density and sampling design affect the results of your study?
- How could you modify this design in the future to more effectively capture the object(s) of interest and/or mitigate various sources of error, uncertainty, or hazards?

Final Deliverables

1. Initial sketch map and plan for survey
2. Equipment list describing the function of base and rover components
3. Field book or data log describing the base station and each rover point
4. A final map or cross section with surveyed points and appropriate symbols. This should contain at least a title, a few general features (roads, sidewalks, etc.), the location of the base station, and rover points, a scale bar, a north arrow, and a legend.
5. Short set of answers to the reflection questions given above.

Rubric

Component	Exemplary	Basic	Nonperformance
General Considerations	Exemplary work will not just answer all components of the given question but also answer correctly, completely, and thoughtfully. Attention to detail—as well as answers that are logical and make sense—is an important piece of this.	Basic work may answer all components of the given question, but some answers are incorrect, ill-considered, or difficult to interpret given the context of the question. Basic work may also be missing components of a given question.	Nonperformance occurs when students are missing large portions of the assignment, or when the answers simply do not make sense and are incorrect.
10 pts **Survey Design**	**9–10** points: Student actively participated in discussion and formulation of the plan. The survey plan is a reasonable and effective design for the area and accounts for potential obstacles. The survey map effectively illustrates the design components.	**5–8** points: Student participated in discussion and formulation of the plan. The survey plan is reasonable but may not be the most effective design or account for potential obstacles. The survey map illustrates most of the design components.	**0–4** points: Student did not participate in discussions or formulations of the plan. AND/OR Is missing various components of a reasonable survey design. Is missing several critical map components
10 pts **Field Book and Equipment List**	**9–10** points: Field book contains well-organized, concise notes on the setup, field survey, and results. Metadata is well kept and includes all appropriate components. An equipment list details both was used and what its function was.	**5–8** points: Field book contains mostly organized notes on the setup, field survey, and results. May be missing 1 or 2 parts. Metadata is kept and includes most critical measures. An equipment list was kept but may describe all items or functions.	**0–4** points: Field book contains some notes, but may not be organized or is missing several components. Metadata is missing several critical components. An equipment list was not kept or used.

10 pts **Final Map**	**9–10** points: Sketch includes all parts of the GNSS survey including the base station, measurement positions, and topography or other features. Sketch includes normal map elements such as titles, north arrow, scale, and legend. Sketch includes appropriate field observations from the site.	**5–8** points: Missing 1–2 of the listed characteristics for an exemplary sketch. AND/OR All characteristics are present but lack detail or are incorrect, showing a lack of comprehension	**0–4** points: Missing 2–4 of the sketch components. AND/OR Most characteristics are present (1–2 missing) but are incorrect, showing a lack of comprehension
10 pts **Write-Up or Discussion**	**9–10** points: The discussion is well written and includes all of the following components: • An answer to a well-articulated science question • Justification of survey design • Challenges and solutions • Discussion of the results Answers all of the reflection questions. Thoughtful discussion of how to improve on survey design.	**5–8** points: The discussion is moderately well written and includes all of the components OR The discussion is well written but weak in 1–2 components or fails to answer some of the questions. Discussion on future improvements is sparse. Improvement is always possible!	**0–4** points: The discussion is poorly written discussion and is missing several components AND/OR The discussion fails to discuss more than 2 critical components or fails to answer questions completely.