2015

Tethered Aerostat Program

CMN • UW – FV • WTC

Ground Truth, Signal and Noise

LEAD STUDENT INTERN WORKSHOP #4 – OCTOBER 17, 2015

UNIVERSITY OF WISCONSIN – STEVENS POINT ROOM B204 SCIENCE

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Contents

Workshop Schedule

Start	Agenda Item	Expected Outcome
8:00	Arrival	Eat Breakfast
8:45	Welcome and Introductions	Introduce new team members. Discuss Year 2
9:00	Program Goals	
9:15	Team roles and responsibilities	Provide strategies to assimilate new members into the team
10:30	Break	
10:45	About Ground Truth Data	Understand the relationship between flight data and calibration/comparison data in experiment design.
11:15	What is good ground truth data?	Overview of the process for obtaining useful ground data for your experiment.
12:00	Lunch	
12:45	Making Sense of Raw Data	Making sense of experimental flight data: what is signal and what is noise? How do you know when you have a true signal?
1:30	Applied Ground Truthing	Using flight data and "ground truth" to establish the validity of your experimental methods.
2:15	Break/Snack	
2:30	Project Team work	Teams develop graphical/tabular displays of ground and flight data comparisons
3:30	Team presentations	Teams present their initial findings with uncertainties
4:00	Team take-a-ways	Teams determine data weaknesses and plan to fix
4:30	Wrap up	Staff discusses next steps and team expectations
5:00	Farewell	

Participants

WSGC

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Welcome – 8:45 AM

- Wisconsin Space Grant Consortium – Christine Thompson
- Introductions
- 2015-2016 Calendar of Events
- Conference Choice

Internet Access

Physics and Astronomy Guests
Alias = TBD
Password = TBD

Calendar

YEAR 2 PROGRAM CALENDAR	
Date	**Project**
October 19	Year 2 Award Letters Sent
October 30	Award Acceptance Letters Due
October 30	TAP Award Announcements
November	1st Stipend Payout
November 13	Proposed Budget Due
February	2nd Stipend Payout
February 12	Conference Chosen/Invoice Submitted
February 20	Workshop #5
April 2	Workshop #6
May	3rd Stipend Payout
August	Final Stipend Payout
August 11	Presentation at the Wisconsin Space Conference @ University of Wisconsin-Superior
September 15	Proceedings Paper Submission
September 18	Year 2 Ends

Program Goals – 9:00 AM

The goal of the WSGC Tethered Aerostat Program is to provide students with a design-build-fly experience that results in the acquisition of scientifically meaningful data and which introduces some basic science and engineering principles behind spaceflight payload design. While the TAP teams are expected to work and learn relatively independently, we will come together three times per year to discuss progress and plan next steps. These workshops have focused on the development of testable scientific questions, the NASA design review process for technology development, micro-controller programming using the Arduino platform, and the use of advanced cameras such as the ADC Tetracam Micro multispectral camera. In the current workshop, we will continue to discuss the importance of ground-testing, understanding when you have data vs. noise, and we will make sure that we all have well-defined and testable scientific questions to our address in our experiments.

Team Roles and Responsibilities – 9:15 AM

WSGC Online Team Building Resources: Tools and Tips

- Team Roles test
- Stages of Team Formation
- The Unique Characteristics of an Effective Team
- Understanding the Stages of Team Formation
- Team Charters
- Sample Team Charter
- So, You're Going to be a Member of a Team

Ground Truth – 10:45 AM

"Ground Truth" is a well-established concept in the earth sciences. Within NASA, *ground truthing* is used to refer to the process of calibrating satellite data using ground-based measurements of the same property. For example, a satellite measuring the surface temperature of the ocean in a particular area will have the temperature data validated by a ship in that region of the ocean making the same measurement using a traditional thermometer. In this way, we can be relatively sure that the instrument onboard the satellite is performing as expected.

Ground Truth is therefore a confirmed match of data between real and sensed data i.e. a field is a field and not a crop of corn, a corn crop is not a soybean crop, a pine forest is not a hardwood stand, a river is not a ditch, lead is not iron, and carbon dioxide is not methane. If you are looking for lead in an air sample you must be confident that when lead is detected it is identified correctly as lead and not iron or any other element.

What is Good Ground Truth Data? – 11:15 AM

Example 1: Consider that your payload camera snaps a photo of a location on the ground while providing you a GPS location of that photograph. You have reason to believe the photo taken is at 90 degrees or NADIR pointing (directly beneath the camera lens). You find the location in the center of the photograph and while on the ground you travel to the known photograph center point and take a ground GPS reading. The reading you acquired while on the ground represents an attempt to "Ground Truth" the accuracy of the pointing angle and the GPS coordinates of the camera.

Example 2: Your payload is designed to measure the level of CO2 in the atmosphere as a function of distance from a known anthropogenic (man-made) source of CO2. To validate your CO2 sensor, you move the payload far from the known source and make 10 measurements over a period of two weeks (during the summer) and average the results. Comparing these results to published data on CO2 levels in the summer provides an assessment of your sensor's calibration as well as an estimate of the uncertainty in the measurements.

- From example 1, what are the likely causes and remedies if you discover that the GPS coordinates of the two measurements do not match? What does "match" mean for a GPS reading? The answer to this question will vary with the goal of the experiment.

- From example 2, what specific calculations could you make to estimate the uncertainty in your measurements of the CO2 data?

Let us now consider payload data from each team and make quantitative comparisons between ground and flight data. Group Work.

Making Sense of Raw Data – 12:45 PM

TAP Teams have some common data such as that from AIM XTRA and partly common data such as Kestrel data and ADC Microcam images, while some data is unique to a particular team such as that from power beaming.

Consider, "When we reason about quantitative evidence, certain methods for displaying and analyzing data are better than others. Superior methods are more likely to produce truthful, credible, and precise findings. The difference between an excellent analysis and a faulty one can sometimes have momentous consequences." Tufte, E. (1997)[1].

- Talk about how cholera was solved, Tufte, (1997).

- Discuss the data (evidence) presented to NASA from Morton Thiokol on "The Decision to Launch the Space Shuttle Challenger", Tufte, (1997).

- From the Tufte (1997) examples, how should the Fox, CMN, and WTC data be displayed such that it makes sense to the intended audience?

[1] Tufte, E. (1997). *Visual and Statistical Thinking: Displays of Evidence for Making Decisions.* Cheshire, CT: Graphics Press, LLC.

Applied Ground Truthing – 1:30 PM

In this exercise teams take their known Ground Truth data and compare and contrast with obtained experimental data while displaying the data in a way it makes sense. For example, does the Go Pro data match the AIM XTRA data? How does that compare with coordinates from Google maps or coordinate source? How can you be sure of the power beaming distance?

Elicit other possible data contrast and comparisons and list them here:

Putting It All Together; Making Displays and Charts of Data – 2:30 PM

Using the ideas of Tufte, (1997) teams combine when appropriate their Ground Truth data with the data they obtained from their first flight while considering the possibilities of kinds of data and how the data can be used from item 5 above.

Teams create displays and charts in Excel or other spreadsheet.

The idea for this exercise is to create a compelling chart, or charts that shows the audience (other teams) that your data “accepts” your experiment ideas and hypotheses or “rejects” your experiment or ideas in a similar way as discussed in Tufte (1997).

Teams Present Take-a-Ways from Ground Truth Exercise – 3:30 PM

- What data should be obtained that was not?

- What data was displayed right and what data could be displayed better?

- Did the experimental data match the Ground Truth data?

- From the charts produced, does the data reflect your original claim of either “accepting” or “rejecting” your hypotheses or was it different than what you expected?

- Other possible take-a-ways:

Wrap Up – 4:30 PM

Farewell – 5:00 PM

TAP WORKSHOP  **EVALUATION QUESTIONNAIRE**

Training Location: Stevens Point, WI
Participant Name (optional): _____
Date: October 17, 2015

INSTRUCTIONS
Please circle your response to the items. Rate aspects of the workshop on a 1 to 5 scale:

1 = "Strongly disagree," or the lowest, most negative impression
3 = "Neither agree nor disagree," or an adequate impression
5 = "strongly agree," or the highest, most positive impression
Choose N/A if the item is not appropriate or not applicable to this workshop. Your Feedback is sincerely appreciated. Thank you.

WORKSHOP CONTENT (Circle)
1=strongly disagree 2=Disagree 3=neither agree nor disagree 4=Agree 5=strongly agree N/A=Not applicable

1. I was well informed about the objectives of this workshop. 1 2 3 4 5 N/A
2. This workshop lived up to my expectations. 1 2 3 4 5 N/A
3. The content is relevant to my job. 1 2 3 4 5 N/A

WORKSHOP DESIGN (Circle)
4. The workshop objectives were clear to me. 1 2 3 4 5 N/A
5. The workshop activities stimulated my learning. 1 2 3 4 5 N/A
6. The activities in this workshop gave me sufficient practice and feedback. 1 2 3 4 5 N/A
7. The difficulty level of this workshop was appropriate. 1 2 3 4 5 N/A
8. The pace of this workshop was appropriate. 1 2 3 4 5 N/A

WORKSHOP INSTRUCTOR (FACILITATOR) (Circle)
9. The instructor was well prepared. 1 2 3 4 5 N/A
10. The instructor was helpful. 1 2 3 4 5 N/A

WORKSHOP RESULTS (Circle)
11. I accomplished the objectives of this workshop. 1 2 3 4 5 N/A
12. I will be able to use what I learned in this workshop. 1 2 3 4 5 N/A

SELF-PACED DELIVERY (Circle)

13. The workshop was a good way for me to learn this content. 1 2 3 4 5 N/A

FOOD SERVICE (Circle)

14. Rate lunch and snack options. 1 2 3 4 5 N/A

IMPROVING THE WORKSHOP…

15. How would you improve this workshop? (Check all that apply.)

___Provide better information before the workshop.
___Clarify the workshop objectives.
___Reduce the content covered in the workshop.
___Increase the content covered in the workshop.
___Update the content covered in the workshop.
___Improve the instructional methods.
___Make workshop activities more stimulating.
___Improve workshop organization.
___Make the workshop less difficult.
___Make the workshop more difficult.
___Slow down the pace of the workshop.
___Speed up the pace of the workshop.
___Allot more time for the workshop.
___Shorten the time for the workshop.
___Improve the tests used in the workshop.
___Add more video to the workshop.

16. What other improvements would you recommend in this workshop?

17. What is least valuable about this workshop?

18. What is most valuable about this workshop?