

Final Report

Summer internship of Doug Weathers

My internship was with the New Mexico Spaceport Authority, from May 12 through August 1, 2008. My mentor was Lou Gomez, Project Manager.

The primary task Lou had for me was to create, using Microsoft Excel, a system that can help NMSA to make some predictions of the windspeed at the site of Spaceport America. Different launch vehicles have different windspeed requirements, and a system that can provide some hint of what the weather might be like on a given day, or a given number of hours in the future, is essential to safe and timely space launches.

Secondary tasks, should I manage to complete the primary one, would be to update a document listing the aerospace technical assets of New Mexico, and to help to create the spaceport operations procedure manual. I was not able to work on these tasks. I was to discover that the difficulty of getting a computer to predict the weather would take up all of the allotted ten weeks, plus an extra two.

I began the internship the Monday after the end of finals week of my sophomore year of studying aerospace engineering at NMSU. The Spaceport America offices were overcrowded, and after an attempt to use the conference room as my “office” began to be a burden both to those trying to hold meetings there and to me, I asked permission to move to the storage room containing the file server and the networking equipment. Being an old IT industry veteran, I felt at home there.



I like tiny hot rooms full of computer equipment!

I quickly discovered that the spaceport site did not have an operating weather station. What I had to work with was data collected by White Sands Missile Range in 2005-2006. The data consisted of readings, taken 15 minutes apart, containing pressure, temperature,

relative humidity, dew point, insolation (strength of the sunshine), windspeed, wind direction, and accumulated precipitation. My first recommendation to NMSA was to start collecting weather data, to use as a baseline for use by the meteorology officer when the spaceport is operational. I would have been glad to have more than one year of data, to test any predictions, and so will the future weatherperson.

Lou gave me the contact information for Blaine Thomas, the person at WSMR who provided him with the data. Blaine was extremely helpful, and helped me realize that there were two problems with the data. First, the windspeed information was an average value, and not the peak value, of the speeds that were measured during the 15-minute measurement interval. For our purposes we needed the peak wind speed. Second, there was a three-month period where the wind direction information was corrupt. That chunk of data needed to be thrown out.

Blaine told me that he believed that a later set of weather data existed, containing peak wind speeds and no bad data. He promised to do his best to get me a copy of this data. In the meantime, I continued to work with what I had.

In a couple of weeks I produced a system that allows the user to filter out records of interest from the weather data and extract them to a table, where they can be quickly graphed. This was only a system for providing some analysis and understanding of the weather that happened during the period covered by the weather data. Prediction was entirely up to the user. Since I am skilled in IT topics and not meteorology, I had no idea how to predict the weather. What I needed was a system that could automatically sort through the weather data, extract the patterns, and use them for making short-term predictions, without knowing anything about the weather. Computer science provides a possible system – an artificial neural network.

But first, we needed to move to a temporary location. We had lost our lease before our new offices were ready, and we had been granted the charity of using the Governor's Las Cruces conference room. Two days of packing files and furniture into storage units, and one evening of rebuilding the office network in the middle of the conference table, and we were back to work.



Belinda, Brent, and Lou take their new office space in stride.

Since space was so tight, my fellow intern Luke Davis of International Space University wangled us office space at the New Mexico Spacegrant building. We had the whole room to ourselves – what luxury! Pat Hynes and the staff at Spacegrant were wonderful hosts – thank you!

I tested a number of neural network packages and settled on one called Tiberius. It was easy to use, compatible with Excel, and inexpensive. The demo version seemed to be able to make good predictions, so I acquired a student license and began working with it.

For the 4th of July weekend Luke and I were called to Roswell, to staff the Spaceport Authority booth at the Roswell UFO Festival. Aaron Prescott was the guy in charge, with an easy manner with the public and all the answers to the questions. We got pretty good at tag-teaming the incoming crowds and by the third day we had the presentation pretty polished. My favorite question to answer was “Why didn’t you guys choose to use Roswell as the spaceport site? We have the biggest runway in New Mexico!” After giving them the reasons for choosing the site (higher elevation, lower population, proximity to WSMR), we told them that the *real* reason was that Roswell has a poor safety record when it comes to landing space vehicles.



I watch in amazement as Luke reels out statistics with a smile. That's not a halo around my head.

The reaction of nearly every visitor was inspiring and very gratifying. A typical visitor would start out never having heard of the Spaceport, be intrigued and excited, and then when they became convinced it was real and happening right here in New Mexico, their faces would light up, they'd exclaim in amazement in delight, and often would drag other people back to our booth to share the good news. It's clear to me that an overwhelming majority of the folks who came to the UFO Festival were wildly in favor of this particular state-funded project.

On the evening of the 4th of July, we packed up and drove to the New Mexico Museum of Space History in Alamogordo to watch the fireworks. Randall Hayes (the director) had invited us to watch from the VIP area, and the buffet took care of our dinner. I have never been so close to a fireworks display – when they exploded I actually felt the fabric of my pants twitch in the pressure wave, like a flag snapping in the wind.

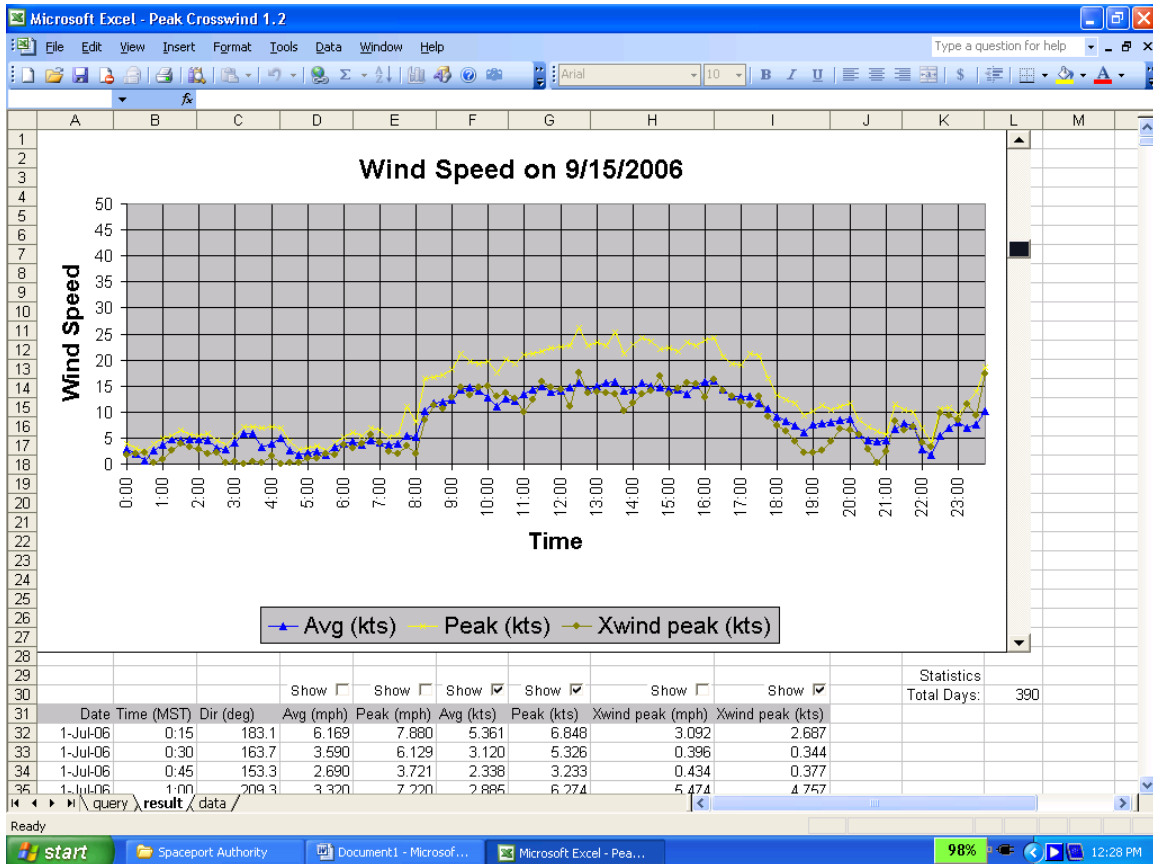


The best picture of the evening. Definitely *not* the best firework

Afterwards we crashed at the house of marketing director Cathy Harper and then drove back to Roswell to man the booth for the last day of the festival. Thank you Randall and Cathy for the gracious hospitality. I am sure that the Spaceport Authority and the Space Museum will be great partners in the years ahead.

Back to work. After several rounds of phone tag, the peak windspeed data arrived from WSMR. It contained only wind direction, average windspeed, and peak windspeed. I set to work using Tiberius, trying to extract good predictions from the software. After several weeks of increasingly frustrating work I concluded that there was not enough different types of information in the latest dataset. Without knowledge of factors such as temperature and humidity, predictions further out than an hour were no better than random guesses. It's still an open question if more data would provide better predictions.

Having already run over my allotted ten weeks, I put a final polish on the datamining spreadsheet, adding features requested by Lou allowing the graphing of speed in both miles per hour and knots and the graphing of more data, making the system useful for both vertical and horizontal launches.



The final version of the Peak Crosswind datamining spreadsheet.

He pronounced himself satisfied with my efforts and asked for this final report.

Here are some of the things I learned this summer:

- Predicting the weather is hard.
- Microsoft Excel is a surprisingly powerful and flexible development environment.
- The Spaceport Authority has an enormous job cut out for them. They have the right people to get it started. They need many more.
- Having a project budget of \$200,000,000 does not guarantee you will have a nice office.
- WSMR is a great partner if you're a nearby spaceport.
- So is the New Mexico Museum of Space History in Alamogordo.
- The people of New Mexico support this project.

My sincere thanks go out to:

- Steve Landeene, Aaron Prescott, Brent Ziarnick, Mary Ann Myers, Belinda Lucero, and Luke Davis from the New Mexico Spaceport Authority, for welcoming me into your crowded workspace, treating me just like a real coworker, and providing an inspiring example of dedicated public servants.

- Pat Hynes, Judy McShannon, Joylynn Watkins, and the rest of the crew at NM Spacegrant, for sponsoring my internship, providing air-conditioned (and mostly quiet) office space, and patiently explaining to NMSU that they should pay me instead of charge me for my work.
- Randall Hayes and Cathy Harper of New Mexico Museum of Space History in Alamogordo, for the best 4th of July *ever*.
- Lou Gomez of NMSA. I never dreamed that I would draw an Apollo project engineer as my mentor. Thanks for the stories and inspiration, and showing that it's possible to actually complete all the paperwork necessary to launch a rocket. And for giving this golden opportunity to a star-struck student. My mission statement is "To make a material contribution to the creation of a spacefaring civilization." Thanks to you, Lou, I feel I've made a start on that already.

Signed:

Lou Gomez, Project Director

Doug Weathers, intern

4 August 2008