



STUDENT LIFE IN COLORADO

Where spaceflight and snowboarding meet

Colorado is one of the most prominent spaceflight states in the United States of America, and the amount of spaceflight activity here is rapidly increasing, as a new generation of spaceflight seems to finally take off. Companies both old and new in the field of spaceflight are spread out throughout this area, and one of the most respected aerospace universities of the US calls this state its home. Obviously, this is a great place for a Delft student, especially with an interest in spaceflight, to spend a few months and learn the 'tricks of the trade'. So my reasons for doing an internship here will immediately be apparent...

TEXT Jon Herman, MSc. Student, Astrodynamics & Space Missions

I wanted to go snowboarding. Seriously. A lot of people think long and hard about how their career should go, and they start during (or even before) their time as a student. I've never been able to do that, I've always just gone for whatever seemed like the most fun at the time. That's why, after many years as an aviation enthusiast, I chose a space engineering track. Spaceflight just seemed more exciting... less 'finished' than aviation. That's why, within that track, I chose the profile for astrodynamics. The math seemed like a lot of fun to me (and I turned out to be right!).

And while I was working my way through those equations, I decided I wanted to live in a place that had mountains and snow, just for a few months. I wanted to work on the weekdays, and ride the mountains in the weekends. I will tell you where I went, how I got there, what I did on the weekdays, what I did on the weekends and how I look back on it.

WHERE I WENT

I spent four months for my internship at the University of Colorado (abbreviated as CU), in Boulder (Colorado, USA).

To be exact: I spent my time at the Colorado Center for Astrodynamics Research (CCAR). Boulder is a little town very close to Denver, and in some ways resembles Delft: about a 100,000 people living there, with a significant student population (about 30,000, so roughly twice the size of TU Delft). CU is not just a technical university however, so people of all walks of life reside in Boulder. In 2011, it was named the "Number 1 party school" by Playboy magazine, which will appeal to some of you but not all. To the latter, rest assured that both the Physics and Aero-



Figure 1. Yours truly at the National Space Symposium in Colorado Springs, posing with the X-37B NASA flight test model



Figure 2. The view from my front door, with my ticket to Los Angeles (and many good afternoons in the mountains before that)



Figure 3. Your average Sunday afternoon walk in Boulder

space programs in Boulder are highly respected in the US. The aerospace program has ranked among the best in the US for years, and in 2011 the Graduate (= MSc/PhD) aerospace program of Boulder was in fact ranked as the number four in the US (beating, for example, the prestigious MIT). Such rankings need to be taken with a grain of salt, rather than as an objective fact, but rest assured that the “work hard, play hard” mentality is very true on both counts for the aerospace engineering department of the University of Colorado.

HOW I GOT THERE

I want to briefly tell you this, because I think it's important to realize that as a Delft aerospace engineering student, you have a reputation before you walk into a room. About a year before I actually began my internship at CCAR, I flew out to the US for a two week road trip, which included attending the Space Shuttle launch STS-131. After a beautiful launch and a fantastic road trip, I was stuck in the US due to the Icelandic ash cloud over Europe. Re-booking my flight home by a week, I flew out to Colorado (I was stuck in Texas, and

had seen enough of it). My ambitions for a snowboarding internship were already present, so in that week I called one of the professors at CCAR to ask if I could come by. A few days later, I visited the university for a few hours and walked pretty much unannounced into the office of Dr. George Born, the department head of CCAR and who would later be my supervisor. Of course, you need to be well prepared for such a visit (even when it's this spontaneous) and show that you know what you're talking about. But make no mistake: Delft students are known and, certainly within the spaceflight community, we are taken seriously when we ask or apply for something. Use this to your advantage! It doesn't matter if your dream is snowboarding, becoming an astronaut or revolutionizing propulsion technology: take 'the long shot' because, if you put some effort into it, you'll be surprised how easy it turns out to make it!

WHAT I DID DURING THE WEEKDAYS

My technical work is somewhat far out and I could easily fill this edition of the Leonardo Times describing it. I chose to

combine my internship with my Master's thesis (and I highly recommend anyone to do so), which involves designing (and optimizing) a trajectory to the far side of the Sun for solar observation purposes. This is interesting for scientific goals (a better understanding of the behavior of the Sun) as well as an early warning system for powerful solar storms about to hit Earth. There are concerns that such storms could do serious damage to the highly electronics dependent civilization that has been built up in recent decades. To find such a trajectory, I looked into using “three body orbits”, rather than the traditional Kepler orbits. This means that instead of essentially creating two separate orbits (the first part only affected by the Earth, the second part only affected by the Sun), I would take into account the gravity of both the Sun and the Earth for the entire trajectory. That explains two out of three bodies; the third body in this equation is the ('massless') satellite whose path I am designing. Such an addition of a single massive body may sound trivial, but in fact greatly complicates the mathematics of your work and creates some pretty un-



Figure 4. The campus of the University of Colorado at Boulder, lively as usual

Figure 5. Elk encountered during a hike in the Rocky Mountains, although they frequently enter Boulder at night

usual orbits. However, it can also save you a LOT of fuel and thus mass (I recommend you do not attempt to contemplate the apparent futility of mass savings on a supposedly massless object). I spent my time at CCAR modeling this type of motion and searching for useful orbits. The experience of CCAR in this field was invaluable to my progress, and in fact allowed me to produce work worthy of presenting in Alaska at the AAS/AIAA 'Astrodynamics Specialist Conference' in August 2011. As I am typing this, I have just finished that presentation. A room full of actual rocket scientists seemed perfectly happy with the results, so take their words for the quality of my advisors at CCAR.

In addition to my technical work, I spent part of my time assisting CCAR in the development of a course regarding Commercial Spaceflight Operations. CU is very quick to pick up on the developments in Commercial Spaceflight (by which I mean companies like SpaceX, Virgin Galactic, etc.), which may well put them ahead of other universities in the near future. Being able to be a part of the first steps in this area has been a very exciting opportunity, and it provided a nice change of pace from the fairly theoretical work I was doing myself.

WHAT I DID ON THE WEEKENDS (and maybe some weeknights...)

Colorado truly is an amazing place to spend your free time. I spent my earlier weekends (February-April) snowboarding, almost every single weekend. Keystone, Breckenridge, Vail (personal favor-

ite), Beaver Creek, A-Basin...there are so many mind-blowing mountains I couldn't believe all of them were two hours or less away by car (there are also bus services for students). It certainly helped that Colorado had one of its record seasons, but honestly I can't imagine any Colorado winter disappointing any skier or snowboarder. When the snow cleared (although some ski areas were open until July!), I spent more time hiking the stunning mountain ranges (practically at walking distance from the campus) and I even bought a motorcycle to ride the mountains in a completely different way (I would later move to Los Angeles with this same motorcycle, for my next internship at NASA JPL). Colorado is known to have some of the healthiest and happiest cities in the entire US, and it's easy to see why: the mountains tower over you every single day you go to work. No matter how exhausted you are after a long week of work, you just have to climb them, ride through them or ski down them in the weekends! And doing so will treat you to some of the most stunning views you could hope for.

In addition to a great natural environment, Boulder has a very active student life. I had a chance to visit many typical American house parties, to a large part thanks to a student community known as 'CU International'. This is a highly active group of international students (mixed with a lot of curious Americans) that will make it very easy for you to build up a social life, get a ride to the ski slopes or pick up any other hobby that may interest you. With them I have travelled through the

Rocky Mountains, Denver nightclubs and many of Boulder's awesome restaurants.

HOW I LOOK BACK ON IT ALL

Writing this, two months since I have left Boulder, I can confidently say it's an incredible little place that I truly miss. I have continued my research with another internship, at the NASA Jet Propulsion Laboratory (JPL) in Los Angeles. There are almost no moons or planets left in the solar system that JPL spacecraft haven't visited, and they even operate the only vehicles ever made that are actually leaving the solar system. The fact that I could walk into JPL and present research that many people there were genuinely interested in is perhaps the best example of the expertise of the people working at CCAR, but also of the way that TU Delft prepares us for the real world of spaceflight.

If I leave you with just three impressions after reading this, I hope they are the following:

1. An internship at the University of Colorado is a great experience.
2. Don't be afraid to take the long shot when you're looking for an internship (or job!). As a TU Delft student (or graduate), you have a strong reputation as soon as you walk through the door.
3. Don't worry too much about your career. Figure out what you want to be doing, not what you should be doing, and find ways to pursue that.

Feel free to contact me (jfc.herman@gmail.com) if you're interested in doing an internship in Colorado, or for any other questions or comments! 🍷