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The Newsletter of the Student Satellite Project at The University of Arizona

UASAT MANIFEST

In This Issue

Jonathan Alberding Chosen as Next SSP Project Manager

by K. C. Hsieh, Project Co-Mentor

SSP has been extremely fortunate to have Chris Lewicki as its founding and incumbent Project Manager. Chris was a senior in Aerospace & Mechanical Engineering (AME) and the President of the national organization of Students for the Exploration & Development of Space (SEDS), when he joined the initiators in December 1996 to get SSP started. He was the natural student leader to assume the office of the Project Manager when SSP was finally organized on May 8, 1997. For mutual interests, Chris stayed on for graduate studies in AME with a NASA Space Grant Graduate Fellowship. (Since then the Arizona Space Grant Consortium has designated this fellowship to the SSP Project Manager, if he or she meets the Space Grant qualifications.) We are indeed fortunate that Chris agreed to stay on as Project Manager into this semester. His ability to keep SSP going and still keeping up with his Master's degree program amazed all of us. He has set a standard for all future SSP Project Managers.

The process of selecting a new Project Manager began with the campus-wide announcement for the search in November 1998 and concluded on February 11, 1999. On the 12th of February, four days later than planned, the selection of Jonathan Alberding was announced. Jon is a graduate student in physics working towards a Master's degree, after which he plans to go for a Ph.D. in biomedical engineering. He has been a Graduate Teaching Assistant in the Physics Department since 1995. His space-related experience includes atmospheric research as a summer intern at NASA's Goddard Space Flight Center under NASA's Technical Experience for Selected Students Program and later as an Arizona NASA Space Grant intern at the University of Arizona, and an independent study in thermal emission in water. Jon's research project for his Master's degree investigates the fluid filtration of blood-vessel wall under non-static conditions. This research aims for eventualuse in arterial drug-delivery systems. He applied for the position of Project Manager for two reasons: first, the technical challenge of unique magnitude and

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Welcome to the Student Satellite Project Newsletter

by Chris Lewicki, Project Manager

With this document we are undertaking a new endeavor in the Student Satellite Project—one that will inform, educate, and enlighten those involved in, related to, or interested in SSP. Our goal is to is to produce an issue three times a year. One at the threshold of the Winter/Spring Semester, another at the end of the Spring semester, and another at the beginning of the school year.

In each issue we will have regular features, as well as timely news items of importance to SSP. Regular features will include articles on alumni of SSP that have gone on to apply their experience in SSP to their career, activities of one of our seven design teams, as well as in-depth look at a featured sponsor of SSP. We will also keep you up-to-date with current developments in the projects as well as important dates.

Our initial audience will include students and alumni of SSP, mentors, advisors, administrators, and sponsors, but who knows what it will develop into. We hope you find the newsletter worthwhile, and we look forward to keeping you informed. ■

NEW PROJECT MANAGER, CONT NUED

inventiveness offered by this project; and second, the opportunity to gain expertise in managing a large and complicated project. To help and motivate others, he serves on the Advisory Board of U of A's Program ACCESS (Accessing Career Choices in Engineering and Sciences) funded by the National Science Foundation.

The Student Satellite Project (SSP) will be two years old on May 8, 1999. The launch of its satellite, UASat, will not take place until it is ready, probably around 2003. This lengthy project of developing a complex system through teamwork will outlast most of its participating students' stay on campus. After all, students are here to graduate and move on. For this reason, it was expected from the start that all Team Leaders and the Project Manager will be "term limited." Although there is no set time limit on the tenure of Team Leaders, which is to be decided by each team, normal study-load and graduation already have most of the teams running now with their second "generation" of leaders. For the exacting role of the Project Manager, it was envisioned that at any given time there should be a Project Manager, flanked and assisted by a Past Manager and a Manager-Elect, all on a one-year shift. This rolling scheme not only would provide continuity to the project, but would also give more students the opportunity to serve in this extremely demanding and yet rewarding office, while still have time left to complete their primary goal of moving on.

The technical topics of SSP maybe new to Jon, even though he has studied the overview of SSP through the SSP website and attended the recent Winter Progress Review. We are confident, however, that Chris and Jon will work together with the Team Leaders for a seamless transition. We welcome Jon and will do our utmost to provide him all the support he needs to lead SSP forward in the next yearlong term. Jon's commitment for two years fits perfectly with the role as Past Manager waiting for him at the end of his tenure as Project Manager. Meanwhile, work to realize the rolling system of managers must get under way as soon as possible. ■

uasat MANIFEST

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Jon Alberding Accepts Project Manager Position

I wish to thank everyone at SSP for giving me the chance to be a part of such a bold and ambitious project. I look forward to working with everyone from members of the Evaluation & Selection Panel and the Mission Advisory Pool to Project Mentors to Team Leaders to the individual SSP members. As an aside to Chris, you've set a standard that I hope to equal, and I hope that you'll be able to look at the project in two years and see your good work has continued.

I really look on SSP as a chance to perform the phenomenal. A group of students, both past and present SSP members, will have launched a satellite into space. Whatever occurs, all SSP members will be able to point to that accomplishment and say, "I was a part of that!" I hope to share that pride along with every other SSP member.

I also wish to say ahead of time that I am looking forward to the guidance and support that all SSP members can give me as we travel down this path with each other. With that, I will conclude by saying thank you to SSP and everyone involved with the organization for selecting me as Project Manager. ■

PROJECT EVENTS

SSP Holds Winter Progress Review and Orientation

Every semester the Student Satellite Project has held a gathering at which current and new members alike can get together and exchange information about the latest progress on UASat and opportunities to participate.

This semester's meeting was the "Winter Progress Review." The meeting was held on Tuesday, January 26th in the ECON 110 lecture hall, and approximately 60 students attended the presentations. Project Manager Lewicki gave an introduction, and gave students an example of how UASat could be deployed from the shuttle by showing a video of the recent "MightySat" deployment from the Space Shuttle.

Following that were 25-minute presentations from all teams, including a live demonstration from the Laser Communications (LCS) team and an animated simulation developed by the Guidance, Navigation and Controls (GNC) team. As presentations concluded, prospective members were able to carry on further discussions with each team's representatives in the hallway outside the lecture hall, and view newly developed "posters" which are now on display in the lobby of the UA Science and Engineering Library.

The meeting concluded with pizza and soda for all who attended. The format proved to be effective, and there will certainly be repeat performances in future semesters!

The Team Presentations from the Winter Progress Review are online at *http://uasat.arizona.edu/documents/presentations/WPR99.* ■

TEAM Q & A

Guidance, Navigation and Controls

An Interview with Gregory M. Chatel, GNC Team Leader

▶ What is your team responsible for on UASat?

The GNC team is responsible for attitude determination and control of the spacecraft. Attitude is the orientation of the spacecraft in a specified reference frame. GNC must meet the pointing and slew requirements of the other teams. For UASat, this means the ability to accurately point at a particular star, the horizon, a spot on the surface of Earth, and the Sun. We will accomplish this through the design of a sensor suite and actuator system.

▶ How often does your team meet?

Our primary meeting time is on Monday evening in the undergraduate controls lab of the Aerospace and Mechanical Engineering Building (AME). We also have workshops and sub-team meetings during the remainder of the week. Our general workshop is on Thursday mornings. It is a free time when team members can spend an hour or two interacting with fellow members and get some work accomplished. We also have sub-team meetings on Friday mornings, one for Kalman filtering and one for Controls. These more-focused meetings allow team members and the faculty mentor to discuss progress made during the week, get help from their peers, and plan for the week ahead.

▶ How many people are on your team? How is the grade level and prior experience distributed?

There are 14 students on the GNC team. The majority of them are AME students, but we also have electrical engineering, computer science, physics, and math majors. There are a several freshman and sophomores, but the most of the team is in its junior or senior years. There are also a few graduate students. Most of the students had no experience with spacecraft design and very little design experience in general prior to joining the project.

▶ What are the most challenging aspects of your team's focus?

Trying to achieve accurate and stable 3-axis control on a satellite generating so little power is very challenging, as is achieving the needed pointing accuracy for the science and laser experiments. For the laser experiment we are required not only to provide high accuracy, but to track Tucson as it passes from horizon to horizon in approximately 5 minutes. Another challenge will be the eventual integration of all the subsystems of the GNC subsystem.

▶ How has your team used outside help?

We've had frequent contact with Honeywell. Last spring we traveled to one of their facilities in Phoenix. We were given a tour and presented to them our reaction wheel design. Our presentation was followed by a couple hours of open discussion between the engineers at Honeywell and members of the GNC team. This brought to our attention things we had overlooked and also support for some of the decisions we had made. This spring we have been invited to return, this time discussing the attitude control system in general.

We also have had contact with engineers from Allied Signal who discussed with us some of the considerations we should make when selecting a GPS unit. Dynacon, a Canadian company that is designing mini-reaction wheels similar in size and performance to the reaction wheels UASat will require, has provided us with feedback and guidance on our designs.

▶ How does your team work with your team mentor?

The team works very well with our team mentor, Ernie Fasse (AME). Dr. Fasse gives us a great deal of his time and always helps to keep the team on track. The Friday focus groups that were mentioned previously are the primary times when members of the team are able to discuss design problems with Dr. Fasse and call upon his experience and expertise in dynamics and controls. In addition helping with the technical aspects of the project, Dr. Fasse is a frequent participant in team social activities helping to bridge the gap between faculty and students.

▶ What are some of the accomplishments of your team?

GNC has accomplished a lot in the past semesters. We have a working simulation of the satellite including graphical visualization of the satellite as it orbits and performs various tasks around Earth. We have chosen our attitude determination and control approach, including the types of sensors and actuators to be used. A working controller has been implemented in the previously mentioned simulation. Commercial sources of expertise and hardware have been located as well as technical documentation on most of the GNC subsystems. A lot of work has been spent developing student designed sun and horizon sensors.

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TEAM PERSPECTIVES

Brian Shucker
Math and Computer Science

"I've gained exposure to the kind of problems that never come up in classes. This project is larger, more complex and more advanced than anything I've ever worked on before, even in the 'project' courses that are supposed to teach teamwork.

It's rare for a sophomore to have ever worked on a project with this kind of scope, and especially rare to be doing original work on such a project. Also, since SSP really is student-run (not faculty-run with student labor), I get to have the experience of making my own design decisions.

Of course, SSP isn't merely a research project; for a young student like me it's my first opportunity to work alongside older undergrads, graduate students, and professors. It's the most challenging project I've encountered so far in my academic career, and so it provides the most room for academic growth.

Before coming to work for the GNC team, I thought it would be years until I could do work at this level, but the environment at GNC (particularly the interaction between students at all levels of education) makes it possible to learn as quickly as my ability allows.

Plus, how many other 19-year-olds can put 'developed 3-axis attitude control software for a small satellite' on the work experience section of their resumes?

And the pizza is good, too."

H GHL GHT ON SSP ALUMN

It's Not All Rocket Science: Life After the UA and SSP at The Boeing Company

by Chris Gee

Growing up and going through the school system in Tucson, you never think about working for a company like Boeing. As a "local" kid, it was a big deal for me to go to the University of Arizona and get involved with a project like the Student Satellite Project, because I knew all the hard work and effort would be worth personal and professional gain. Nevertheless, with the end of my college career only a few months away, a Computer Engineering degree almost in hand, and at the beginning of my job search for a professional career, I thought my chances of working for a place like Boeing were slim to none.

For those of you that may not remember me, I was the Team Leader of the original Science and Technology Initiatives Team, which has since been renamed the Laser Communications (LCS) team. Having been involved with the Student Satellite Project (especially as a team leader) gave me extra ammunition for my job search and reminded me that classes and grades were only part of the picture.

"The Student Satellite Project helped me to develop the skills to deal with a 'real world project,' and demonstrated to me the importance of teamwork on any complex effort, both lessons that were quickly recognized by recruiters."

At the 1997 Fall Career Fair, I interviewed with recruiters from many leading companies, including AMD, Unisys, and Raytheon. The same questions were asked repeatedly: "What types of leadership involvement have you had?" — "What have you done other than these standard classes?" — and most significantly, "What's this Student Satellite Project?" On top of the other work that had I done, it was SSP that really helped me to "dazzle" the recruiters. They were very intrigued and impressed to learn of a project driven by students who were willing to take initiative and get involved in something very challenging, and have fun doing it. My experience with SSP proved very valuable, as it made me more competitive with other interviewees. The project helped me to develop the skills to deal with a "real world project," and demonstrated to me the importance of teamwork on any complex effort, both lessons that were quickly recognized by recruiters.

One of the recruiters I met with during the fair was Steve Monks, a software manager for the F-22 avionics program at Boeing. During my interview with him, SSP came up and I described for him the entire effort and the part of the project that I was involved in. I knew from that point on that something good had finally happened. Before a site visit or further interviews, Boeing made me an offer. After my site visit to Seattle several months later, I knew that I had found the place to live and company to work for.

Currently, I'm working with the Airborne Laser System/Project (or ABL for short), which is an effort by Boeing, TRW, Lockheed Martin and the U.S. Air Force to develop an airborne platform that provides a defense against tactical theater ballistic missiles (like Iraqi scuds) in the boost phase. The main "tools" of the system are various sensors and an accurate, airborne, high energy laser.

I'm working with the Battle Management segment, which is responsible for being the "brains" of the aircraft and which will be the focal point for the mission crew, in terms of where they run the mission and all hardware, other than the aircraft itself. My area of responsibility deals with the design and implementation of software for the Controls and Displays for the operator consoles. In other words, I'm writing C/C++ code and using standard commercial off the shelf tools (COTS) to develop X/Motif based displays.

Many of the people I work with have been at Boeing for more than 10 years, and as the "new guy" I have learned to listen closely to the lessons of their experience. However, I am often expected to come up with an idea or way to deal with a problem on my own. This is where my experience in SSP has helped me the most. Being a team leader for LCS helped prepare me to make decisions and taught me how to get started when faced with an incredibly open-ended problem.

Working on SSP also help me interact in a team environment, teaching me to be open to other people's ideas, to be able to accept criticism about my designs, and to appreciate the importance of making compromises. My work at Boeing also benefits from my learning on SSP how to stay on a schedule and keep myself organized and motivated — procrastination has no place on a project of this magnitude. If I don't do the work, I'll suffer both personally and professionally. That's sort of the penalty for being part of a high visibility project for The Boeing Company.

The keys to my success have been a willingness to work hard, and a courage and confidence in my ability to successfully take the initiative. These skills helped me get involved in the Student Satellite Project and become a team leader there. Working with the students of LCS and the other members of the project helped me demonstrate these skills to Boeing, and I'll always benefit from having the value of such skills reinforced and highlighted while still a college student. ■

SPONSOR H GHL GHT

SSP Thanks the Foundation Cariñoso

In 1988, a family in Tucson started the Foundation Cariñoso as a way to provide support to local and national non-profit organizations. The name 'Cariñoso' is the Spanish word for caring, and as such it reflects the Foundation's motivation to be of service to those in need. The goal of the Foundation is to help fund groups who are actively working to improve the community. In doing so, the Foundation has focused the majority of its donations into areas such as education, disabilities, the environment, community need, and medical and scientific projects.

In 1998, the Foundation Cariñoso generously gave SSP a $2,000 scholarship to support worthy students. Barry Goeree (Guidance, Navigation and Controls) was awarded $800, and Will Betush (Data & Command Handling), Guthrie Partridge (Science) and David Sing (Science) were awarded $400 each for their respective contributions.

The Foundation Cariñoso has set an example to the community in its caring for the future of the community. SSP expresses its gratitude to the Foundation and will work hard to be worthy of supports from civic organizations like the Foundation Cariñoso. ■

SPONSOR H GHL GHT

Representative Jim Kolbe on the Merits of SSP

The Student Satellite Project is pleased to have received a ringing endorsement from Rep. Jim Kolbe, a 15-year member of Tucson's Congressional delegation:

"Higher education sets the pace for the economic, technological, as well as cultural growth of Arizona. Learning to work together on solving complex problems that require multiple talents becomes increasingly a necessity as we grow. I am encouraged by the initiative of the Student Satellite Project at the University of Arizona in setting an excellent example for this kind of learning.

"As your Representative in the US Congress, I am very committed to supporting this project at the highest levels, so more of our students, local industries and community at large can benefit from this new and needed opportunity in higher education." ■

SPONSOR H GHL GHT

Kaman Corporation Offers Use of Test Facilities

The efforts and aspirations of the Student Satellite Project have attracted the attention of many of Arizona's leading technical and engineering companies. Kaman Corporation, an aerospace company with research facilities here in Tucson, has generously offered the use of their specialized test facilities for the systems integration phase of SSP. These facilities are used to simulate the stressful environments of launch and Earth orbit, by subjecting the completed satellite to extreme shock, wide ranges of temperatures, vacuums and the like, and represent critical and hard-to-find resources for the latter stages of UASat's development.

Since 1945, the Kaman Corporation has been an industry-leader in the development and production of helicopters and helicopter systems for military and commercial applications. Current military technology programs at Kaman include the Magic Lantern®, an airborne laser-based mine detection system developed by the corporation's Electro-Optics Development Center based here in Tucson, and the SH-2G Super Seasprite helicopter, a multimission, intermediate maritime helicopter that is used by the United States Navy Reserve.

The Electro-Optics Development Center in Tucson was established in 1987 and investigates the potential of using imaging lidars (light detection and ranging) for airborne reconnaissance of submerged mines and submarines The number of EODC employees has grown from one at its inception to about 50 at present. EODC provides a full range of services including experiment design, system modeling and simulation, system conceptual and detailed designs, fabrication, integration, testing, operation, training, and data analysis.

Kaman Aerospace has been very enthusiastic about the benefits of programs like SSP for the future technical workforce in Tucson and the rest of Arizona. Their facilities in Tucson were sited here due to the strong optical and engineering community of which the University of Arizona is a primary catalyst, and to which they are sure alumni of SSP will add their talents. ■

The Student Satellite Project welcomes sponsorship or contributions from industry and the community. If your company or organization is interested in aiding the Student Satellite Project in some manner, please contact our office at (520) 621-2574.

TEAM PERSPECTIVES

Dave Faulkner
Mechanical Engineering

"SSP has given me a learning experience that can't be duplicated in the classroom. We get to work with a diverse group of engineers and scientists, from many disciplines, finding the solutions to real-world problems."

Matthew J. Angiulo
Aerospace Engineering

"I think that being involved in SSP has helped me see how all the things I'm learning day-to-day fit together. It's also really fun to be able to apply this material to something that actually is going to fly."

In addition to the tangible design and documentation done by the GNC team, the knowledge base/talent pool has been steadily increasing.

More importantly, a sense of team cohesion has been developed and also a team environment has been established to allow team members to have fun and make progress at the same time. Team social events have ranged from playing pool at a local bar to camping and spelunking south of Tucson. Turnout is always high at such events.

▶ What are your team members gaining from their involvement with SSP and your team?

The comments offered by GNC team members Brian Shucker, David Faulkner and Matt Angiulo (see **TEAM PERSPECTIVES** sidebar) are fairly typical of statements each member of GNC has made as they have spent more and more time on the project. The personal excitement and academic challenge students get working on the project is quite exhilarating.

▶ What could your team really use right now? In the future?

Right now, the single most helpful item for the GNC team would be a more powerful computer. We have access to two low-end Pentiums, but we are increasingly hitting the boundaries of the computers' capabilities with each revision of our simulation and visualization code. We have high-end design and analysis software packages, such as Pro/E and Satellite Toolkit/VO, that have been almost useless in our efforts thus far due to the limitations of our computers.

In the long run, we could use funding and donated hardware, such as sensors and reaction wheels.

▶ What are the near-term goals for your team?

One near term goal is to continue to increase the accuracy of our simulations, especially in terms of sensor and actuator models. Soon, we hope to implement an extended Kalman filter in the simulation, which will allow us for the first time to test the performance of the attitude determination and control schemes we have selected.

We are also documenting the work done and soon to be done on the team. This includes making a multimedia CD-ROM to be used not only as a source of information but as a way of advertising ourselves to companies. It will be a great way of getting new GNC members and members of other teams up to speed on the GNC subsystem. ■