The Student Satellite Project at the University of Arizona: A Guide for New Members

The Student Student Satellite Project is the cooperative effort of students at the University of Arizona to design and build UASat, a small satellite will be launched from the Space Shuttle's Hitchhiker Ejection System in 2001. The project has maintained an evolving membership of 100 students since its inception during the Fall 1996 semester — students drawn from all levels of graduate and undergraduate work, from doctoral candidates to freshmen, and from a wide array of majors and disciplines.

Step (1) — Choose a Team: Designing and constructing a satellite is a complex process, and to make the job easier and more efficient the project is organized into (7) teams, each responsible for one subsystem of UASat. Each member of the project is based in one of these teams:

— **Science:** the Science team is tasked with designing the primary science instrument onboard the satellite. Three experiments will utilize this instrument: the primary experiment will count lightning flashes above the earth's surface, the secondary experiment will seek to detect and image sprites — a recently-discovered class of atmospheric phenomena — and the remaining experiment will conduct a photometric survey of a standard set of stars.

Typical SCI Majors
Atmospheric sciences
Optical engineering
Astronomy
Planetary sciences
Physics

— **Tracking, Telemetry and Command:** The TTC team is tasked with providing the communications link between the spacecraft and the ground. They must provide both the spacecraft and the groundstation with radios, modems, and antennae. All of the groundstation software is currently being developed in Java with some C for the best portability and upgrade capability.

Typical TTC Majors
Computer science
Electrical engineering
Computer engineering

— **Power Generation and Distribution:** The PGD team is tasked with selecting, designing and integrating for the solar arrays, battery subsystem, and distribution of power throughout the satellite on standard regulated buses. The PGD team will be utilizing the ORCAD suite of design, layout and simulation tools for its circuit design tasks.

Typical PGD Majors
Electrical engineering
Computer engineering

— **Data and Command Handling:** The DCH team is tasked with developing the 'spacecraft computer' that will handle command detection, verification, distribution and execution. This subsystem must interpret, store and carry out all commands uplinked, as well as perform general internal housekeeping functions. Typical processes will include executing attitude determination and control algorithms and transferring data and commands between subsystems. The DCH team will be utilizing the ORCAD suite of design, layout and simulation tools for its design of the subsystem.

Typical DCH Majors
Computer science
Computer engineering
Electrical engineering

— **Guidance, Navigation and Controls:** The GNC team is tasked with determining the absolute position and attitude of UASat, and controlling the pointing of the satellite at specified targets. With two exceptions, all of the GNC components will be built in-house, as it is economically infeasible to purchase the components commercially.

Typical GNC Majors
Aerospace engineering
Mechanical engineering
Electrical engineering

— **Laser Communications:** the LCS team is designing an experimental laser communications uplink. The receiver will be integrated into the science instrument onboard the satellite. The team has already prototyped both ends of a communications link using a Manchester encoding technique, and has tested it successfully with a direct serial link as the transmission medium. Currently the team is ready to test the optics with lasers.

Typical LCS Majors
Optical engineering
Electrical engineering
Computer science

— **Mechanical Structures:** the MSA team is tasked with designing the body, to which all other subsystems and experiments are to be mounted. This team is also responsible for routing the subsystem interconnect cables throughout the spacecraft. The students will perform both the mechanical and thermal analyses of the entire structure. The team uses the parametric design capabilities of Pro/Engineer in the design of UASat, which allows easy visualization of concepts and quick design studies on the components.

Typical MSA Majors
Mechanical engineering
Materials science eng.
Aerospace engineering

Each of these teams has their own website, so if you would like more information visit the appropriate page at

http://www.physics.arizona.edu/ssp/team-pages.html

Step (2) — Fill out online Membership Form: Once you know which team you would like to work on, fill-out our online Membership Form at

http:/www.physics.arizona.edu/ssp/membership.html

Step (3) — Sign-up for the SSP E-mail Lists: Much of the day-to-day communication within and between teams in the project takes place via e-mail. To sign-up for any of these lists, use the form on the SSP website at

http://www.physics.arizona.edu/ssp/email/

You should sign-up for the general 'SSP Students' and 'SSP News' lists, as well as the list appropriate for the team you are interested in.

Step (4) — Check when Team Meetings are held: Find out when and where on campus the team you've selected meets. During the semester all the members of a team meet together once a week to review team activities, assess progress made and assign new tasks for the following week.

You should attend your first (and perhaps second) team meeting with the goal of observing what tasks team members are currently working on, and developing an idea of how you'd like to join in their efforts. By your third team meeting you should arrange with the team leader for you to be assigned a task, or to join one of the subteam projects.

If you can't make the specified meeting time due to class or other commitments, send an e-mail to the team e-mail list and let the team leader know that you are still interested in working with the project — there may be ways to begin working with the team even if you cannot attend team meetings at the moment.

Step (5) — Keeping a Notebook of your Research: Because the project is composed of students, a constant challenge is trying to stem the 'brain drain' of knowledge — as a student graduates, his or her knowledge of the project needs to be passed on to his or her fellow team members. To accomplish this, all members of the project are required to maintain a lab notebook of their work and research with the project. The leader of your specific team will provide you with a notebook after the first few team meetings you attend. You may find it useful to review some guidelines on keeping a proper lab notebook:

http://www.physics.arizona.edu/ssp/documents/misc/notebook.html

Step (6) — Have fun! We hope you'll find the Student Satellite Project at the University of Arizona to be one of the most challenging, rewarding and enjoyable experiences available on campus. *Enough with the problem sets and lecture notes... now it's time to make it real!*