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Special Programs

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Special Programs

B.I.G. B.L.U.E. V Balloon-Launched Experiment www.engr.uky.edu/bigblue

March 17, 2007 — Colorado Mission Successful, and close to much more ...

Two years ago, in early April, 2005, the BIG BLUE 3 team was preparing to travel to Colorado for the first test of inflatable wings; the AIRCAT had not yet made its first flight with rigid wings (let alone inflatable wings), and the Micropilot autopilot was not working (with the Pax River competition only two months away). Less than two years later, the BIG BLUE V (BB V) team has now successfully completed the final Colorado mission to verify systems are ready for a high-altitude flight to demonstrate the feasibility of inflatable wings for Mars exploration. A lot has been accomplished.

The objectives of the BBV Colorado Mission were defined in Fall, 2006: 1) to verify long-range (near 100,000-ft altitude) communication with the commercial Piccolo autopilot, 2) to verify use of the autopilot for mission operations such as to initiate inflation, take pictures, monitor sensors, cut away and deploy the emergency parachute, and 3) to test at high altitude a new lightweight aircraft. The aircraft was designed with a target total weight of less than 15 pounds, compared to the almost 40 pound weight of the AIRCAT with inflatable wings. The team of Kentucky and Oklahoma State students has worked hard since August, with a Critical Design Review (CDR) at ILC Dover and many long hours in the lab and many cold days at the flying field.

On March 17, the day dawned with freezing temperatures, but a clear blue sky perfect for spotting the descending flight string — the FAA requirement to cut away at low altitude. Two days of flight testing included many successful parachute deployment flights and enough autopilot tests, so the team was ready for a low-altitude cut-away mission. The mission simulation of the integrated aircraft finished at 2 a.m. Saturday with a long list of problems to be fixed, but most of these had been corrected before leaving the Fatton sunroom for the remote site. A loose connection in the cut-away circuit was finally located and the aircraft was quickly readied for launch as the balloon handlers kept the balloon from harm.

The launch and lower ascent proceeded as planned, with clear Amateur Radio-Band Television (ATV) transmissions from Edge of Space Sciences (EOSS) and UK cameras. As the balloon reached about 70,000 feet, aircraft control was successfully



transferred from the launch-site ground station to the down-range ground station. The communication link to the autopilot was stronger and over longer distances than expected. The command was issued to inflate the wings. The ATV view showed the wings inflated, but folded because a restraint had not released. Then the restraint suddenly let go and the wings snapped open. The team watched the TV monitors in shock as the fuselage failed under the unexpected dynamic load and the right wing fell away. Clear thinking by Dr. Michael Seigler, a new faculty member in mechanical engineering at UK, prevailed at the remote autopilot ground station and the mission concluded with a successful cut-away from the EOSS parachute and successful deployment of the aircraft emergency chute. The aircraft was recovered, but the lost right wing is still missing. Spectacular video was recorded, along with

amazing images. The success of this year's efforts, confirming the operation of the autopilot and aircraft means that BIG BLUE is finally ready for the last step — high-altitude flight! Go BIG BLUE!



Students Make Rocket Science a Daily Pursuit By Crystal Kinser Bruno

To an unfamiliar visitor, this gray, cramped room appears to be a storage area. On first glance, the dusty equipment stacked against the walls and on tables meshes together to become a single, massive instrument. An attempt to distinguish the individual elements yields a surprising discovery of an antique Morse code keyer. A modest sign — “KySat UK Ground Station” written in dry-erase marker on a white board — is the only obvious feature identifying the purpose of the room. Yet even the sign is generally only visible to regular visitors — those already well acquainted with the room and its equipment.

On this particular December afternoon, seven people squeeze into the oversized closet to watch a computer screen. On it, a circle moves over a flattened image of Earth, highlighting a dot on the map representing Lexington, KY. The circle will move over the “Horse Capitol of the World” for about ten minutes, enough time to send a text message, receive an E-mail reply and repeat. This seemingly ordinary exchange is actually quite the opposite: the visitors to this room just “spoke” to the International Space Station.

While the destination is extraordinary, the message sent is anything but. The short note simply identifies the call sign and location of the sender. The returning E-mail confirms the message was received. Nothing significant has been communicated but, like their Ham radio predecessors, much of the excitement for these students comes in

knowing their signal could reach so far, in the event they ever did have something important to say.

“Talking to the different satellites is a challenge,” says Tyler Doering, a first year graduate student in electrical and computer engineering. “It proves we have built a ground station capable of communicating with these satellites.”

Hopefully, people will soon be trying to talk to another satellite, one developed by Doering and his fellow colleagues.

For the students working on the KentuckySatellite (KySat) program, rocket science is a daily pursuit. Whether it consists of incorporating a new component into satellite design, collaborating with fellow students across the state, “talking” to satellites, or writing a blog on the program’s Web site, every day consists of new challenges for the satellite team.

Founded in 2006, KySat is made up of students and faculty advisors from universities across the state — each university working with the others to produce a single satellite — the challenges of which are difficult to overcome. Doering has encountered this problem first-hand.

“One of the hardest things about this project is trying to coordinate work between the universities,” he says. “We also have to figure out on our own what the problems are and how to fix them. No one is here telling us what the next step is.”

Luckily, Kentucky Virtual Campus has helped to solve one of those issues. KYVC allows the students at each university to meet with one another virtually to talk, share pictures, and work out problems.

According to Doering, the students have the opportunity to work on every aspect of the satellite, from design to launch, a responsibility welcomed by senior mechanical engineering major, Mike Gailey.

Gailey is one of two UK undergraduates currently working on KySat. He has been interested in aerospace technology for some time, and has chosen to work with KySat over other, higher-profile opportunities.

“KySat is great because at UK, there aren’t a lot of classes geared toward aerospace engineering, but working with KySat gives me the chance to work in the field,” Gailey said. “I’ve had other co-ops before but here I have much more responsibility with the project. I actually had a co-op at the Kennedy Space Center and I quit so I could work with KySat.”



Prasanna Padmanabhan, Tyler Doering, and James Lumpp.

Special Programs (CONT.)

Working with KySat hasn't been a natural progression for Doering. As an undergraduate, Doering mapped out his career as an engineer and was even offered a position with General Electric Co. However, the possibility of working with KySat changed his mind.

"At first I didn't want to work in the aerospace industry," he said. "But after working on KySat, it's opened my eyes to all the different aspects of the field. I am learning to work with other disciplines of engineers and learning how the whole system works instead of just my own little part. I definitely plan on entering into the aerospace industry after this experience."

James Lump, an associate professor in electrical and computer engineering and faculty adviser for KySat, appreciates the chance these students have to undertake such an assignment.

"I've been involved in University projects for 22 years and I haven't seen any project like this," Lump says. "To have the chance to build something to go into space — it's the ultimate design opportunity. These guys are ready to step right into leadership positions after this experience."

The satellite being designed by KySat is 10 centimeters cubed — about the size of a large grapefruit or a softball. Compare that to Sputnik 1, which was nearly 23 inches in diameter, or to the International Space Station, measuring over 100 feet in each direction.

"It usually takes 10 years or more to develop a large satellite," Doering says. "But with these small ones, we can turn around a satellite in one to two years."

The ability to develop a satellite quickly is appealing to companies seeking to benefit from a booming digital society and explains the importance of the KySat program. The eventual goal of KySat is to successfully launch a satellite of its own design into orbit. Once accomplished, companies can approach KySat to design satellites for them, for whatever purpose they require, based on the design specifications KySat develops.

Ensuring the satellite can withstand the forces of space means testing it in extreme temperatures and shaking it at 10 Gs in all directions, over twice the speed of a typical roller coaster. G-force is a measurement of the combined forces of acceleration and gravity on an object.

"With a satellite, you have one chance to get it right — you have to succeed," Lump says.

KySat's first mission to space was not as successful as hoped. On Dec. 2, 2007, 20 students and KySat members traveled to NASA's White Sands Test Facility in Las Cruces, NM, for a Dec. 5 sub-orbital launch. The Space Express satellite was supposed to climb to an altitude of 62 miles in order to test its systems outside of the Earth's atmosphere and then return to Earth. From launch to landing, the entire process should have taken four minutes.

However, after a successful liftoff, the launch vehicle failed and the student payload never reached its target altitude. Although the mission was considered a failure, the students involved with KySat have learned important lessons and are looking forward to their next launch.

"We learned several things the day before the launch that if we knew sooner, we might have been able to change," Gailey says.

Doering agrees. "Going through this process once will really help when we go to do this again," he says.

KySat has plans to launch another satellite in mid-2008 and is in the midst of negotiations with launch sites around the world to determine who will launch Kentucky into space.

The target altitude for the next satellite will be between 370 and 500 miles above the Earth and it will stay in orbit for 10 years. The satellite's payload could include a camera, radio, solar cells, and sensors measuring everything from speed to temperature. Students will of course be able to "talk" to it and give it commands.

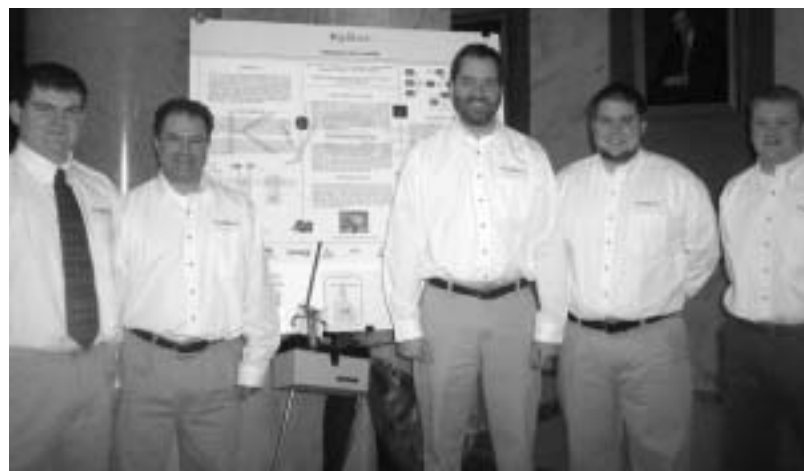
"Cube sets are great to work on because you can test new technologies to be used on larger satellites," Gailey says.

"Once you work on a project this fun, nothing else seems as exciting," says Sam Hishmeh, a second-year graduate student in electrical engineering. "This is the future of a lot of technologies."

"The space race started 50 years ago and in 15 years we went from space to the first man on the moon," Lump says. "It totally changed the way we teach engineering. Now we're entering into a new space age. The technologies we develop for the small satellites will evolve into other technologies."

KySat is an ambitious joint-enterprise involving public organizations, colleges and universities, and private companies in a student-led initiative involving the design, build, launch, and ground operation of small satellites and other spacecraft to promote science, technology and engineering, innovation, and education. If you would like more information about KySat or want to get involved, go to www.kysat.com.

The satellite is 10 centimeters cubed and must be tested to withstand the forces of space.



Dale McClure, Benjamin Malphrus, James Lump, Daniel Erb, and Tyler Doering, presenting a display at the "Posters at the Capitol" event in Frankfort.

Special Programs (CONT.)

Wildcat Pulling Team www.bae.uky.edu/tractorteam

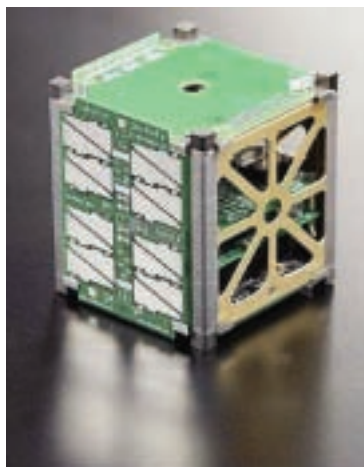
The Quarter Scale Tractor Team once again represented the UK Colleges of Agriculture and Engineering in exemplary fashion. The 2007 American Society of Agricultural and Biological Engineers Quarter Scale Tractor Design Competition was held in Peoria, IL, from May 31 through June 3. UK was one of 28 teams from the U.S. and Canada registered for the competition. UK placed fourth overall in the competition behind Kansas State, Purdue, and Université Laval.

UK also received the Manufacturability Award and placed fourth overall in pull performance, in addition to bringing home the Cook-Off Main Event prize. For more information about the event and for the final scores from this year, visit UK's biosystems and agricultural engineering Web site. Each student team must design and build a 1/4 scale tractor

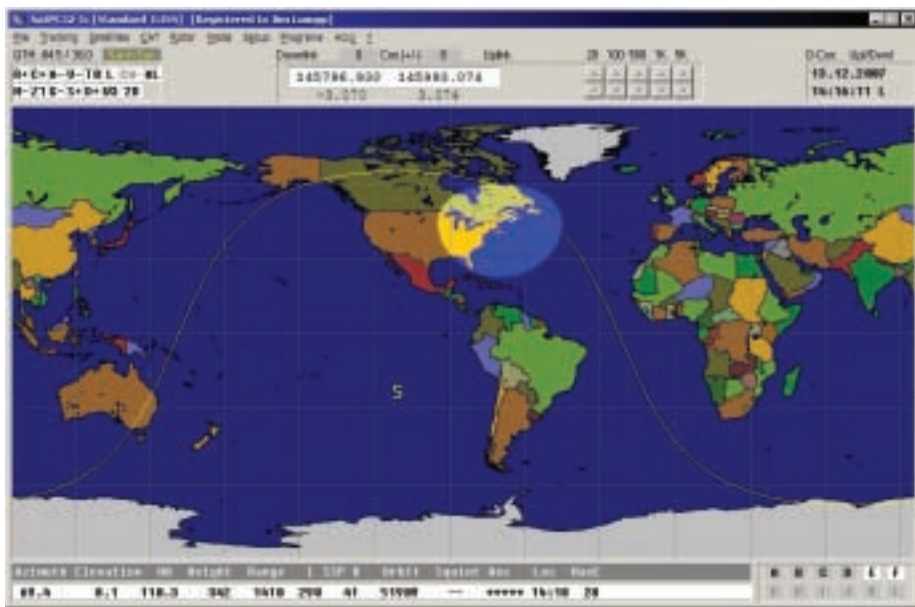
capable of pulling a weight transfer sled. All designs must conform to a rigorous set of rules including many safety features. The design competition consists of performance assessment (tractor pull and maneuverability course), a formal design presentation, a formal written design report, and judging of tractor designs in which teams of engineers assess features of the tractor, including safety, serviceability, and manufacturability. Over 80 professional engineers from industry judge and score the competition. UK's team has already begun preparations for next year's competition with the goal of finishing first place overall.

The Wildcat Pulling Team is optimistic about the upcoming year and looks forward to once again representing the team sponsors and the University of Kentucky in this competition. Feel free to contact one of the team advisors, Tim Smith (tsmith@bae.uky.edu), Scott Shearer (shearer@bae.uky.edu), Larry Wells (lwells@bae.uky.edu), and Tim Stombaugh (tstomb@bae.uky.edu), or call (859) 257-3000 if you have additional questions.





Students Make Rocket Science a Daily Pursuit, See page 128



Satellite Tracking

Upcoming Undergraduate Scholarship Events and Deadlines

Kaleidoscope, Volume 6

The *University of Kentucky Journal of Undergraduate Scholarship* is published once each year, at the beginning of the fall semester. All contributions to the journal are refereed by a standing editorial board and guest referees and editors. Articles, reports, and other creative works may be submitted by any undergraduate student at the University of Kentucky. All submissions must be accompanied by an endorsement by a University faculty member who has agreed to attest to the scholarly quality of the work and to serve as faculty mentor for editing and final submission of the work. Detailed guidelines for submission are available at <www.uky.edu/kaleidoscope> .

Deadlines for Volume 7, Fall, 2008:

February 24, 2008: Electronic letter of intent to submit, including a brief description of the nature and contents of the proposed submission sent to the editor. (rst@uky.edu) (optional)
April 4, 2008: Complete submission prepared according to the guidelines delivered electronically to the editor. (rst@uky.edu)
May 2, 2008: Notification of acceptance/rejection and instructions for suggested/required revisions.
July 15, 2008: Final, revised submission delivered electronically to the editor.

National Conference on Undergraduate Research

"The mission of the National Conferences on Undergraduate Research (NCUR®) is to promote undergraduate research, scholarship and creative activity done in partnership with

faculty or other mentors as a vital component of higher education."

The 2007 NCUR conference will be held April 11-12, 2008, at the Salisbury University (MD). Visit the NCUR Web site at <http://ncur.org/basics/index.htm> for general information on NCUR; visit www.salisbury.edu/NCUR22 for details and deadlines for the conference.

Oswald Research and Creativity Awards

All current UK undergraduate students are eligible to submit a paper or other creative work to be considered for an Oswald Research and Creativity award. The competition categories in which papers and projects may be submitted include: (1) Biological Sciences; (2) Design (architecture, landscape architecture, interior design, etc.); (3) Fine Arts (film, music, painting, sculpture, videotape, etc.); (4) Humanities: Creative; (5) Humanities: Critical Research; (6) Physical and Engineering Sciences; and (7) Social Sciences. **The deadline for submission is March 6, 2008.** Visit the eUreKa! website at: www.uky.edu/eureka for details, application forms, and official rules. See pages 123-126 for winning submissions from last year's Oswald Awards program.

Office of Undergraduate Studies Research and Creativity Awards

As a means of promoting educational experiences for students, the Office of Undergraduate Studies offers Research and Creativity Grants during the summer term. The grants are intended to take advantage of the rich resources available through the libraries, the laboratories and, most especially, the academic personnel at the University of

Kentucky. Undergraduates in all areas of intellectual inquiry are eligible, and students at many different levels of matriculation have received support. **The deadline to submit applications is February 28, 2008.** For details regarding eligibility, and application forms visit the eUreKa! website at: www.uky.edu/eureka. See page 100-112.

UK Undergraduate Research Program

The University of Kentucky Undergraduate Research Program (UKURP) creates research partnerships between first- and second-year students and faculty researchers. The program offers students the opportunity to work and learn alongside a research faculty member. Undergraduate students are given the real-life experiences of working in laboratories and other scholarly settings; developing a research abstract; presenting their projects at symposiums and professional conferences; publishing their findings; and meeting others in the international community of scholars. In other words, students are given a jump-start on their career. For more details and deadlines for applications, visit www.uky.edu/eureka/ukurp. See pages 115-116.

Additional Information

Additional information regarding undergraduate scholarship and creativity programs, conferences, competitions, and opportunities is posted on the Web site of the Office of Experiences in Undergraduate Research and Kreative Activities, eUreKa! at www.uky.edu/eureka.

