American Institute of Aeronautics and Astronautics

UC Berkeley Chapter

2014 Prospectus

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To whom it may concern,

Thank you for your interest in supporting the UC Berkeley AIAA chapter,

The University of California Berkeley AIAA chapter includes two different competition teams: the Design, Build, Fly Competition and NASA RASC-AL Robo-Ops Competition. For their first time since founding, both teams qualified to compete.

Out of 100 participating schools, Berkeley's DBF team placed 45th on the report portion of the competition and placed 55th overall. Although we have room for improvement, this was still a great leap forward and a foundation for the team's future. This year, our team emphasized low weight to optimize performance, whereas most other teams emphasized thrust, utilizing heavier but more powerful propulsion systems. This focus on weight reduction rendered our UAV more susceptible to 35mph wind speeds during competition which ultimately limited our performance results. Through the lessons learned from competition, we have have improved and reorganized our design priorities. We are currently working on several more planes over the summer, experimenting with different wing and motor configurations.

Our Robo-Ops Team participated in the RASC-AL's Robo-Ops Competition, representing the West Coast as the only team to pass the initial design round. This allowed us to take part in the full competition hosted at the Johnson Space Center in Texas. After the design proposal, our team manufactured the Mars rover and programmed the communications and controls software. While we did not place in the top three this year, the experience has taught us many lessons in creating an effective team that will help us in the future. We have already begun implementing changes in our 2015 design from the lesson learned at competition. In an effort to strengthen our teams while giving back to the UC Berkeley community, we have created a UC-sponsored class in which we teach 30 students about machining, design, and theory relating to aeronautics and astronautics. Many of these students go on to join our competition teams.

Lastly, we also seek to provide professional guidance for our members and the UC Berkeley engineering community. Most recently, we hosted an event with a Boeing fellow in Fall 2013 and plan to coordinate more social and professional events in the future. Our mission is for members to enjoy the practical application of their education as they learn the fundamentals of engineering design through hands-on experience and teamwork.

As we plan for the next year, we look forward to building on past experiences and expanding the presence of AIAA UC Berkeley, both in competition and on campus.

Thank you,

Aaron Wienkers
University of California Berkeley AIAA Chapter

About AIAA

Brief Description: The American Institute of Aeronautics and Astronautics was created in 1963 through the merger of the American Rocket Society and the Institute of Aerospace Sciences. AIAA's role today is to represent the interests of its community of 35,000 individual members as well as to provide younger members with hands-on experience through competitions and seminars.

Hands-on Student Competitions:

- **Design/Build/Fly (DBF)** – Sponsored by AIAA, Cessna Aircraft Company, and Raytheon Missile Systems, this annual competition invites graduates and undergrads from across the world to design, build, and test an unmanned, electric powered, remote-controlled airplane that can complete a pre-determined set of tasks. The 2013/2014 competition had participants create a "Rough Field Bush Plane" that could hold at least four pounds of cargo meant to represent two medical attendants and two patients. Last year's competition had 100 participants and 80 finalists. Teams are ranked based on a score system corresponding to the quality and speed of which a plane completes each mission. Specifics about scoring and more information can be found at http://www.aiaadbf.org/.

- **RASC-AL Robo-Ops Competition** – The Robo-ops competition is an annual competition hosted by the National Institute of Aerospace and NASA (no association with AIAA) at the Johnson Space Center in Texas. The competition is split into two stages. In the fall, teams from schools across the United States propose their rover design to NASA. From the design proposals, the top eight teams receive grants to manufacture their rovers to compete at the JSC proving grounds. Each rover is tele-operated from the team's school, simulating a real mars rover. More information about the RASC-AL Robo-Ops competition can be found at http://nia-cms.nianet.org/RoboOps/index.aspx.

For more information about AIAA, please visit http://www.aiaa.org/

AIAA's UC Berkeley Chapter

DBF

About DBF

- **Participates in AIAA's annual Design-Build-Fly competition**
- **Founded in Fall 2011. First successful entry into DBF competition in Spring 2014.**
  - **Placed 55th out of 100 schools**
- **Competition team of 13 undergraduates**
  - **10 Mechanical Engineering majors**
  - **2 EECS majors**
  - **1 Business major**
- **Hosts seminars and professional events**
  - **Last semester, invited a Boeing fellow to speak about boomerang aerodynamics**
- **Budget of $400 per semester (excluding travel expenses).**

Robo-Ops

About Robo-Ops

- **Participates in the National Institute of Aerospace's RASC-AL Robo-Ops competition**
- **Founded in Fall 2012. First successful entry into the Robo-Ops competition in Fall 2013.**
  - **Only West Coast school to advance to the final round**
- **Competition team of 15 undergraduates**
  - **8 Mechanical Engineering majors**
  - **7 EECS majors**
- **Budget of $400 per semester, excluding NASA funding (NASA funds up to $10,000 of construction expenses if team qualifies for final round).**

Goal: Serve to provide members of the UC Berkeley community with education, experience and opportunities in Aeronautics and Astronautics.

Leadership and Organization

<u>President</u>: Aaron Wienkers

- B.S. Mechanical Engineering, emphasis in astronautics – *Dec 2014*
- Computational Fluid Dynamicist – *Lawrence Livermore Labs*
- Flight test Engineer – *Boeing*

<u>Treasurer</u>: Andy Zhao

- B.S. Business Administration, B.A. Economics – *May 2015*
- Research Associate – *Dodge & Cox*

<u>Robo-Ops Lead</u>: Piyush Prakash

- B.S. Mechanical Engineering, emphasis in autos – *May 2016*
- Electronics lead – *UC Berkeley Formula SAE*

<u>DBF Lead</u>: Howard Lee

- B.S. Mechanical Engineering, emphasis in fluids – *Dec 2014*
- Researcher – *UC Berkeley computational laboratory*

<u>Robo-Ops Lead</u>: Brian Lau

- B.S. Mechanical Engineering – *May 2016*
- Hydrogen Drivetrain Engineer - *Toyota*

<u>Design Leads</u>:
Sirisha Varigonda
Akhil Devarakonda
Wesley Guo
Casey Getz
Terence Cho

<u>Propulsion Lead</u>: Jeffrey Kurohara

B.S. Mechanical Engineering – May 2016

<u>Structures Lead</u>: Justin Lee

B.S. Mechanical Engineering – May 2016

<u>Aero Lead</u>: Armin Askari

B.S. Mechanical Engineering – May 2017

<u>Design Team</u>

<u>Propulsion Team</u>

<u>Structures Team</u>

<u>Aero Team</u>

Fall 2011 – Fall 2013: Did not advance to the final round of the DBF competition

- No sources of external funding capped our budget at ~$70/semester
- Leadership was focused on club-building activities such as marketing, compliance, and funding.
- Little institutionalized knowledge of design strategies and competition logistics

Fall 2013 – Spring 2014: Advanced to the final round and placed 55th out of 100 schools

- Received a $400/semester allocation from the UC Berkeley Engineering Student Council
- Strong leadership and dedicated team members
- Explicit timetables allowed a margin of error

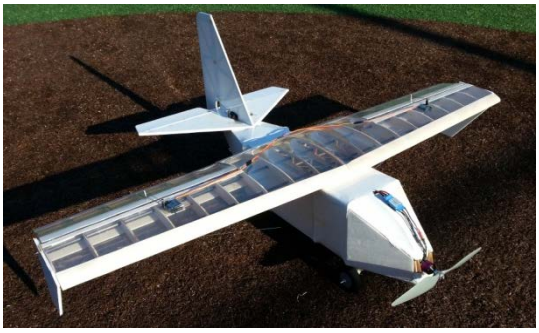
The 2014 International DBF competition, held in Wichita, Kansas

Mission: *1)* Completion of a rough-field taxi mission without damage to the plane, *2)* timed ferry flight with no payload installed on plane, *3)* maximum-load flight over a predetermined distance, *4)* timed flight with a predetermined payload used to simulate two emergency patients and two attendants.
For more information about 2014's competition see www.aiaadbf.org/2014_files/2014_rules_31Oct.html

Breaking down our score and performance

2014 AIAA Design/Build/Fly Competition Final Results (Cont'd)

Place	University	Report Score	Taxi	M1	M2	M3	Mission Score	RAC	Final Score
41	New Mexico Tech	76.33	1.0	0.29	1.00	0.00	1.29	10.12	9.71
42	Embry-Riddle Aeronautical University Prescott Campus	83.00	1.0	0.86	0.00	0.00	0.86	7.44	9.57
43	University Of Notre Dame	85.75	1.0	0.57	0.00	0.00	0.57	5.36	9.16
44	University of Kentucky	79.50	1.0	0.29	0.00	0.00	0.29	2.58	8.83
45	West Virginia University	90.50	1.0	0.29	0.00	0.00	0.29	6.02	4.31
46	U. of Tennessee Knoxville	69.00	1.0	0.57	0.00	0.00	0.57	10.60	3.73
47	Johns Hopkins	80.00	0.2	0.57	0.00	0.00	0.11	3.38	2.71
48	Veermata Jijabai Tech Institute	85.50	1.0	0.29	0.00	0.00	0.29	9.42	2.60
49	New Mexico State University	74.00	1.0	0.29	0.00	0.00	0.29	8.62	2.46
50	UCSD	89.38	1.0	0.00	0.00	0.00	0.00	N/A	
51	Nanyang Tech University	88.00	1.0	0.00	0.00	0.00	0.00	N/A	
52	University of Arkansas	87.00	1.0	0.00	0.00	0.00	0.00	N/A	
53	Yildiz Technical University	87.00	1.0	0.00	0.00	0.00	0.00	N/A	
54	University Of Central Florida	84.88	1.0	0.00	0.00	0.00	0.00	N/A	
55	University Of California Berkeley	80.00	1.0	0.00	0.00	0.00	0.00	N/A	
56	Ghulam Ishaq Khan Institute	79.50	1.0	0.00	0.00	0.00	0.00	N/A	



Final model of competition plane

Report Score: 80.00 (avg.: 76.81)

Highlights
- Our first report submission

Room for improvement
- Limited testing infrastructure (testing rigs, real-time data logging, etc.)
- More experience with aircraft design

Taxiing Score: 1/1

Highlights
- Sturdy construction
- Good maneuverability
- Rigorous testing

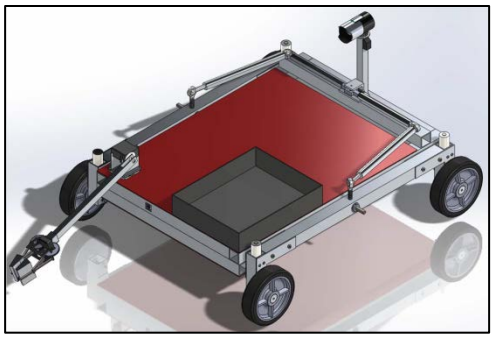
Mission Scores: 0
(plane tumbled out in M1, disqualifying us for M2, M3)

Highlights
- Lightest plane in the competition
- Competitive design despite low budget

Room for Improvement
- More powerful hardware (competitors' motors were ~3x more powerful than ours)
- More testing adjusting for weather phenomena
- Better manpower allocation and knowledge transfer

Fall 2012 – Spring 2013: Did not advance to the final round of the RASC-AL Robo-Ops competition

- Design team too small to create a compelling rover design
- Lack of machining experience hindered prototyping and delayed the design process
- Little institutionalized knowledge of competition strategies and process
- Drivetrain design lacked pinpoint maneuverability
- Arm only designed with 2 degrees-of-freedom, hindering ability to pick up rocks.

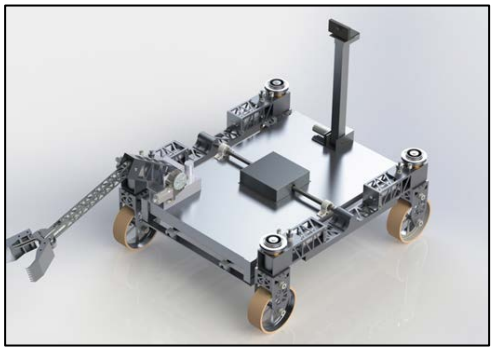


Fall 2012 Final Prototype Rover CAD

Fall 2013 – Spring 2014: One of eight schools to advance to the competition's final round

What we did right

- Collaborated with UC Berkeley to provide units to new members of the Robo-Ops team in exchange for design and machining training. This helped double the amount of manpower from a year earlier.
- Prototyping began summer 2013 and rigorous timetable was laid out and followed.
- Only West Coast school to reach the final round
- Submitted a competitive design despite being a new entrant.



Fall 2013 Final Rover CAD

What we need to improve

<u>Current progress</u>

- New Swerve Drivetrain design allows 360° pinpoint maneuverability
- Redesigned arm with 4-degrees-of-freedom allows extra flexibility to pick up rocks
- New in-house wheels now provide more traction on sandy terrain compared to rubber wheels

<u>To do within the next 6 months</u>

- Redesign power management and circuitry fail-safes
- Reduce size and weight of rover
- Improve telecommunications response times and ease-of-control
- Upgrade swerve drivetrain system's rigidity while reducing weight

DBF

Short-term goal: Finish among the top 15 schools at the 2015 DBF competition

How to get there

- Purchase better components, testing rigs, and real-time sensor equipment
- Outsource a portion of our machining and manufacturing to maximize design and engineering time
- Ensure team members specialize to reduce redundancies of effort
- Additional manpower through better marketing and team member retention by designing workflow to give more responsibility to new members.

Robo-Ops

Short term goal: Finish among the top 3 schools at the 2015 RASC-AL Robo-Ops competition

How to get there

- Finish prototype by the end of Fall 2014
- Design a smaller and more efficient rover (previous design was cumbersome and had limited mobility)
- Specialize team members' time by creating subdivisions in the design team
- Expedite training for new team members (machining, software, circuits, suggested courses)
- New supplies for prototyping with an emphasis on wheels and a smaller controller unit

AIAA

Long-term goal: Create a system to transfer knowledge between generations of leadership to achieve consistent success in competition.

How to get there

- Formalize a training program for new members which will include machine shop instruction, a rigorous software tutorial (Solidworks, Python, XFoil), and work specialization.
- Lock in a sponsor to provide us with a consistent budget that will allow us to be competitive with other schools
- Establish hierarchical path towards leadership succession

Sponsorship

Sponsorship Levels*:

Sponsorship Level	Offerings	Amount
Blue	Your company's name featured on the homepage of our website	**$500**
Gold	Same offerings as level Blue + your company's name on our banner & other paraphernalia and AIAA-organized recruiting events for your company	**$1,000**
Platinum	Same offerings as level Gold + your company's name on our competition plane and lunar rover	**$2,000**

***** The sponsorship levels are only suggestions; we are open to discuss terms and amounts

Any donations to our organization will be distributed between the two divisions based on budgetary needs

Uses:

DBF:

- Better components
- Testing rigs, software licenses, and outsourced machining
- Travel expenses
- Marketing and competition team expansion
- Professional events for members

Robo-Ops

- Better components (stronger & lighter motors, more powerful electronics)
- Custom parts vs. repurposed off-the-shelf items
- Travel expenses
- Advanced stage early prototyping

Contact Us

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