Mechanical & Aerospace Engineering Department

INDUSTRIAL ADVISORY BOARD MEETING

Friday, November 21, 2009
Edward Rice Conference Room
UCLA
UCLA MAE Industrial Advisory Board Meeting Agenda

9:00 – 9:15   Arrival, refreshments

9:15 – 9:30   Welcome, Introductions   Prof. Ann Karagozian, VC, Industrial Relations

9:30 – 10:15  Departmental overview, updates   Prof. Adrienne Lavine, Department Chair

10:15 – 10:45  Industrial outreach programs   Prof. Ann Karagozian

10:45 – 11:00  Student group project:

   AIAA Design-Build-Fly Project   Gaurav Bansal (gbansal@ucla.edu)

11:00 – 11:15  Break

11:15 – 11:45  Inst. for Technology Advancement   Dr. Derek Cheung

11:45 – 12:15  New MAE Faculty Member   Prof. Richard Wirz, Aerospace Propulsion

12:15 – 12:45  Online MS Program   Prof. Chris Lynch

12:45 – 1:45  Buffet Luncheon with Faculty

1:45 – 3:15  More student group projects:

   Supermileage Team   Brett Rosenthal (barose@ucla.edu)

   AIAA Hybrid Rocket Project   Victor Reznikov (netvic@gmail.com)

   Formula Zero Team   Jeff Jonokuchi (midnighttofurun@gmail.com)

   SAE Baja Project   Rohit Mitra (rmitra01@yahoo.com)

   Robotics Projects   Andrew Boggeri (amboggeri@gmail.com)

   ASME BattleBots Project   Alexander Jozefov (ajozefov@gmail.com)

3:15 – 3:30  Greetings   Dean Vijay K. Dhir

3:30 – 4:30  Open Discussion   Jason Hatakeyama, IAB Chair

4:30 – 5:30  Wine & Cheese Reception
Mechanical and Aerospace Engineering

Industrial Advisory Board
November 21, 2008

Adrienne Lavine, Chair

Vice Chairs:
Xiaolin Zhong, Graduate Programs
Robert M’Closkey, Undergrad. Programs
Ann Karagozian, Industrial Relations
# Department Overview

## Faculty and Staff

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<table>
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<tr>
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<tbody>
<tr>
<td>Ladder Faculty:</td>
<td>31</td>
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<tr>
<td>Joint Faculty:</td>
<td>3</td>
</tr>
<tr>
<td>Emeritus Faculty:</td>
<td>14</td>
</tr>
<tr>
<td>Adjunct Faculty:</td>
<td>6</td>
</tr>
<tr>
<td>Lecturers:</td>
<td>40</td>
</tr>
<tr>
<td>Research Staff:</td>
<td>15</td>
</tr>
<tr>
<td>Administrative Staff:</td>
<td>22</td>
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## Recognitions

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<tr>
<th>Recognitions</th>
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<tbody>
<tr>
<td>Society Fellows:</td>
<td>23</td>
</tr>
<tr>
<td>CAREER or Young Investigator Awards:</td>
<td>11</td>
</tr>
<tr>
<td>NAE members:</td>
<td>7</td>
</tr>
<tr>
<td>Regular Faculty:</td>
<td>3</td>
</tr>
<tr>
<td>Affiliated Faculty:</td>
<td>1</td>
</tr>
<tr>
<td>Emeriti:</td>
<td>3</td>
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## Publications

<table>
<thead>
<tr>
<th>Publications</th>
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<tbody>
<tr>
<td>Journal Articles:</td>
<td>90</td>
</tr>
<tr>
<td>Conference Papers:</td>
<td>61</td>
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<tr>
<td>Books and Book Chapters:</td>
<td>10</td>
</tr>
<tr>
<td>Patents:</td>
<td>10</td>
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**Fiscal Year 2007-2008 Sponsored Research Budget - Total $26.5M**

(Fiscal Year 2007-2008 Sponsored Research Expenditures - Total $14.3M)

- Federal: $20.7M (78%)
- Industry: $2.9M (11%)
- University & Endowment: $2.7M (10%)
- State: $0.2M (1%)
Major Fields

- Dynamics
- Fluid Mechanics
- Heat and Mass Transfer
- Manufacturing and Design
- MEMS/Nanotechnology
- Structural and Solid Mechanics
- Systems and Control
Selected Grants (25 of 75 Active)

Predictive Capabilities, Analysis & Experiments for Fusion Nuclear Science & Plasma Chamber Research (Abdou)

Multifunctional Design of Hybrid Composites for Load Bearing Antennas (Carman)

Nanoimprint Lithographic Process of the Fabrication of 3D Multilevel Crossbar Circuits (Chen)

CAREER: Massively Parallel Light-driven Droplet Manipulation Platform for Large Scale Multiplexed SIN (Chiou)

Self-Pumping Micro Fuel-Cell System with Scalable Monolithic Construction (CJ Kim)

A Mechanistic Study of Nucleate Boiling Heat Transfer under Microgravity Conditions (Dhir)

CAREER: Numerical Investigations of Biological and Bio-inspired Locomotion (Eldredge)

Survival and Reliability Assessment of Chamber Structure Materials for High-Average Power Laser Systems (HAPLI) (Ghoniem)

Equipment for Control, Filtering and System Identification for High Energy Lasers and Laser Communications (Gibson)

Design of Polyurea-Bonded Steel/E-Glass Composite Joints under Dynamic and Hygrothermal Loads (Gupta)

Biomimetic Multifunctional Composites for Autonomic Aerospace Structures (Hahn)

The Center for Systemic Control of Cyto-Networks (Ho)
Selected Grants (25 of 75 Active)

A Numerical Study of Turbulence Physics in Hypersonic Boundary Layers (JJ Kim)


Manufacturing and Multifunctional Characterization of Load Bearing Energy Harvesting Structures (Ju, Hahn)

Forcing of the Non-Isothermal Transverse Jet for Aerodynamic Control (Karagozian)

Numerical Simulation of Pulse Detonation Rocket-Induced MHD-Elector (PDRIME) Concepts for Advanced Propulsion Systems (Karagozian)

Interfacial Tension and Contact Angle of Ionic Liquids (Kavehpour)

CAREER: Membrane-protein Interactions and the Mechanics of Cell Organelles (Klug)

NSEC: Center for Scalable and Integrated Nano Manufacturing (SINAM) (Lavine, Hahn, Ho, Tsao)

Piezoelectric Sensor/Actuator Rosettes for Noise and Vibration Control (Lynch)

On-line System Identification and Control Strategies for Improving the Performance of Inertial MEMS (M'Closkey)

Nanoporous Pyroelectric Materials for Direct Energy Conversion of Waste Heat into Electricity (Pilon)

Integrating Collision Avoidance and Tactical Air Traffic Control Tools (Speyer)

Simulations of Turbulent Flows with Strong Shocks and Density Variations (Zhong)
Department Comparison

US News & World Report Graduate Rankings
– ME: 14th, AE: 15th

<table>
<thead>
<tr>
<th></th>
<th>MAE</th>
<th>Depts. ranked higher ME &amp; AE Combined*</th>
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<tbody>
<tr>
<td># Faculty</td>
<td>32</td>
<td>58</td>
</tr>
<tr>
<td>Research Expenditure/Faculty</td>
<td>$460,000</td>
<td>$400,000</td>
</tr>
<tr>
<td>Undergraduate Enrollment/Faculty</td>
<td>22.9</td>
<td>13.0</td>
</tr>
<tr>
<td>Graduate Enrollment/Faculty</td>
<td>8.5</td>
<td>6.4</td>
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*Based on 2006-07 data.
Three faculty hires in last three years

• Pei-Yu (Eric) Chiou, Assistant Professor
  Berkeley Ph.D.
  – Biophotonics, nanophotonics, BioMEMS/NEMS, 
    electrokinetics, microfluidics and biofluidics, guided 
    self-assembly, high throughput single cell analysis.
• Chris Lynch, Professor, Georgia Tech
  – Ferroelectric materials and applications: Constitutive behavior, reliability, fracture mechanics, actuator and sensor design. Applications to aerospace structures.
• Richard Wirz, Assistant Professor
  Caltech Ph.D., JPL senior engineer
  – Electric and micro propulsion, low temperature plasma and plasma discharges, spacecraft and space mission design, alternative energy generation and storage.
Planned hiring

- Systems and Control – one mid-career person in the review process
- Energy – two individuals in nuclear energy under consideration, but not yet in formal process
Graduate Applicants

- 2002-03: 433 Foreign, 150 Domestic
- 2003-04: 351 Foreign, 204 Domestic
- 2004-05: 239 Foreign, 167 Domestic
- 2005-06: 209 Foreign, 197 Domestic
- 2006-07: 213 Foreign, 191 Domestic
- 2007-08: 231 Foreign, 208 Domestic
- 2008-09: 218 Foreign, 175 Domestic
Graduate Program Statistics

Graduate Student Admissions

Graduate Students Registering (%)
Graduate Program Statistics

Graduate Total Enrollment

Graduate Students Registering

02-03 03-04 04-05 05-06 06-07 07-08 08-09

0 20 40 60 80 100 120 140
Graduate Program Statistics

M.S. Graduates

<table>
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<tr>
<th>Year</th>
<th>AE 02-03</th>
<th>AE 03-04</th>
<th>AE 04-05</th>
<th>AE 05-06</th>
<th>AE 06-07</th>
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<td>103</td>
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Ph.D. Graduates

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<th>AE 02-03</th>
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## Graduate Diversity

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<tr>
<th>Grad. Enrollment</th>
<th>MAE</th>
<th>National</th>
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<tbody>
<tr>
<td>Female</td>
<td>05-06 17.6%</td>
<td>14.0%</td>
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<tr>
<td></td>
<td>07-08 13.3%</td>
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<tr>
<td>Minority</td>
<td>05-06 6.8%</td>
<td>5.5%</td>
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<td></td>
<td>06-07 10.9%</td>
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Undergraduate Program Statistics

Freshmen and Transfer Admissions and Registrations

- % of freshmen admitted
- % of admitted freshmen registering
- % of transfers admitted
- % of admitted transfers registering

Undergraduate Program Statistics

Undergraduate Total Enrollment

<table>
<thead>
<tr>
<th>Year</th>
<th>AE 206</th>
<th>AE 199</th>
<th>AE 211</th>
<th>AE 205</th>
<th>AE 215</th>
<th>AE 224</th>
<th>ME 321</th>
<th>ME 358</th>
<th>ME 369</th>
<th>ME 362</th>
<th>ME 386</th>
<th>ME 495</th>
<th>ME 508</th>
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<tr>
<td>02-03</td>
<td>527</td>
<td>554</td>
<td>568</td>
<td>573</td>
<td>591</td>
<td>710</td>
<td>732</td>
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freshmen enrolled

transfers enrolled
Undergraduate Program Statistics

Underrepresented Minority and Female Graduation Rates (as Percent of Total)

- 2004-05
- 2005-06
- 2006-07
- 2007-08

% minority

% female

- 2004-05
- 2005-06
- 2006-07
- 2007-08
Budgetary Considerations

• State budget cuts
• Rising costs of benefits, utilities, maintenance
• This year – 10% reduction in resources for outside instructors and TAs
• Next year – quite likely this category will be decimated
• Impact on other resources is unknown
• Perfect storm – spike in enrollment at time of plummeting resources
INDUSTRIAL ADVISORY BOARD MEETING

MAE Programs and Industrial Outreach

Prof. Ann Karagozian
Vice Chair, Industrial Relations
MAE Department Educational Programs

- **B.S. programs** in both ME and AE afford students extensive educational and practical experiences:
  - **Strong technical background** in fundamental areas (fluids, solids, structures, thermodynamics, heat transfer, controls, materials)
  - **Significant breadth** in technical areas and technological systems (energy, manufacturing, design, aircraft, spacecraft systems)
  - **Meaningful capstone design** (“system engineering”) and development experiences within each major
  - **Stimulating design, development, and testing experiences** through extra-curricular professional organizations and projects (AIAA, ASME, SAE)
  - **Opportunities for industrial experience** via summer internships and part-time employment
MAE Department Educational Programs

- **M.S. programs** in both ME and AE afford students strong educational, research/practical experiences:
  - **Strong technical background** in fundamental areas (fluids, solids, structures, thermodynamics, heat transfer, controls, manufacturing, MEMS)
  - **Opportunities for research in fundamental areas** (M.S. thesis plan, 7 courses)
  - **Opportunities for applied research or industry projects** (M.S. comprehensive exam or project plan, 9 courses)
  - **New Online M.S. program** meets needs for distance learning
- **Ph.D. programs** in both ME and AE afford students extensive educational and research experiences to prepare them for professions in applied research or teaching
MAE Industrial Outreach: Benefits to UCLA

- Exposure for our students to current industry directions and technological projects (can lead to internships, scholarships, permanent employment)

- Exposure for our faculty to current industry directions, technological projects (can lead to collaborations, partnerships, extension of industry IRAD programs)

- Positive exposure of our educational and research activities to our primary “customers”
  - Impact on future directions in teaching and research
  - Impact on unrestricted funding to the department
  - Impact on school rankings by industry
Exposure to exceptionally strong future employees for internship and permanent positions

Exposure to our faculty and their research for potential collaborations, partnerships, investment, joint proposals

Exposure to MAE advanced degree programs for current employees’ continuing education

Ability to influence the future directions of the department and hence the education of future generations of engineers
  • i.e., “preserving the seed corn”, even in difficult economic times
What is “seed corn”?

- Literally, the “good quality seeds (as in kernels of corn) that are reserved for planting”, to be used for future crops, future harvests

- Figuratively, the best or most precious components of our society or community or resources that are essential to the future (growth, survival)
What are the issues in eating “seed corn”?

LITERALLY,
- When there has been an unusually harsh winter, OR
- When there hasn’t been responsible storage or preservation of seed corn during times of plenty, OR
- When a natural or economic disaster occurs, forcing one to reduce or completely consume the available seed corn
- Then seed corn is eaten for near term survival, and the viability of future crops is very much in jeopardy

FIGURATIVELY,
- When there is an unusually harsh financial climate, OR
- When there hasn’t been responsible resource preservation or strategic planning during times of plenty, OR
- When a disaster occurs that focuses attention on the near term survival of an organization,
- Then resources needed for developing future capabilities are consumed now, and the viability of future advances and programs is very much in jeopardy
Seed Corn was in jeopardy before Sept. 2008

- “We have observed a troubling decline in the number of U.S. citizens who are training to become scientists and engineers, whereas the number of jobs requiring science and engineering (S&E) training continues to grow.”
  National Science Board, S&E Indicators, 2004

- “America today faces a serious and intensifying challenge with regard to its future competitiveness and standard of living. Further, we appear to be on a losing path... Suddenly, Americans find themselves in competition for their jobs not just with their neighbors but with individuals around the world.”
  “Rising above the Gathering Storm”, Nat. Acad., 2005
U.S. Government investment in “seed corn”

Trends in DOD "S&T", FY 1994-2008 *
in billions of constant FY 2007 dollars

Source: AAAS analyses of R&D in AAAS Reports VIII- XXXII.
* - FY 2008 figures are President’s request.
Medical research appropriated outside RDT&E; appropriated in "6.2"
accounts before 1999.
FEB. ’07 © 2007 AAAS
U.S. Government investment in "seed corn"
U.S. Government investment in “seed corn”

Trends in Basic Research by Agency, FY 1975-2008 *

in billions of constant FY 2007 dollars

Source: AAAS analyses of R&D in AAAS Reports VIII-XXXII. * - FY 2008 figures are President's request; 2007 figures are latest AAAS estimates of basic research in 2007 appropriations. Basic research only.
MARCH '07 REVISED © 2007 AAAS
Other countries’ “seed corn” is nurtured well

A YOUNG ADULT’S PROBABILITY OF GETTING AN S&E DEGREE HAS RISEN MUCH LESS IN THE UNITED STATES THAN ABROAD

Figure 3. Ratio of Natural Science and Engineering First University Degrees Awarded to 24-Year-Old Population, by Country, 1975 and 1999

Rand, 2003
Between 1990 and 2002, Asia’s production of S&E BS degrees increased by 49% vs. An increase in U.S. production of S&E BS degrees of 21% in the same period.

### TABLE 2. Science and engineering bachelor’s degrees and engineering baccalaureates by selected region and country/economy: 1990 or closest year and 2002 or most recent year available

<table>
<thead>
<tr>
<th>Region and country/economy</th>
<th>1990 or closest year</th>
<th>2002 or most recent year</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>S&amp;E</td>
<td>Engineering</td>
</tr>
<tr>
<td>Asia</td>
<td>898,000</td>
<td>311,400</td>
</tr>
<tr>
<td>China</td>
<td>268,400</td>
<td>115,900</td>
</tr>
<tr>
<td>India</td>
<td>205,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30,700</td>
<td>9,600</td>
</tr>
<tr>
<td>Japan</td>
<td>187,500</td>
<td>81,400</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3,400</td>
<td>900</td>
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<tr>
<td>Philippines</td>
<td>71,100</td>
<td>29,400</td>
</tr>
<tr>
<td>Singapore</td>
<td>3,700</td>
<td>1,200</td>
</tr>
<tr>
<td>South Korea</td>
<td>79,300</td>
<td>28,100</td>
</tr>
<tr>
<td>Taiwan</td>
<td>24,400</td>
<td>9,000</td>
</tr>
<tr>
<td>Thailand</td>
<td>24,200</td>
<td>6,800</td>
</tr>
<tr>
<td>EU-15</td>
<td>284,300</td>
<td>92,700</td>
</tr>
<tr>
<td>United States</td>
<td>329,100</td>
<td>64,700</td>
</tr>
</tbody>
</table>

NA = not available
EU = European Union
S&E = science and engineering

Decline in engineers
Potential Solutions:

Universities:
- Keep students engaged in the field (especially early!)
- Plant the seed corn early, to develop future students (i.e., those currently in elementary and middle school)
- Work to keep the curriculum relevant, but maintain the necessary technical depth to move into future arenas
- Keep focused on our ultimate objectives (education and research), making research opportunities available to graduates and undergraduates

Industry:
- Keep seed corn issues in mind for current and future organizational health
- Engage with universities as well as high schools to provide role models, collaborations, “seed planting”
- Maintain “best practices” in research and educational partnerships
MAE Industrial Affiliates’ Programs

- **Basic Level ($10,000/ year):**
  - Representation on MAE Industrial Advisory Board
  - Three free registrations at the HSSEAS Technical Forum *(scheduled for Thursday, April 23, 2009)*
  - List of exceptional undergraduate and graduate students completing degrees (e.g., GPAs > 3.4)
  - Technical papers and pre-prints by faculty and students on request
  - Advance notice of departmental seminars and colloquia of interest
  - In-building and University Library use upon request
  - Hard copies of MAE Annual Review and other relevant news and professional information
MAE Industrial Affiliates’ Programs

- **Gold Level ($15,000/ year):**
  - All of the benefits of Basic Membership, plus:
    - Opportunities for yearly Industry-Sponsored Seminar Days, Recruitment Activities

- **Platinum Level ($25,000/ year):**
  - All of the benefits of Gold Membership, plus:
    - Assignment of a Faculty Liaison to facilitate collaborations, partnerships with the IA
    - Annual seminar at the IA company by the Faculty Liaison or another MAE faculty member
    - UCLA student assigned to work on an IA-sponsored project (either at UCLA or the company)
    - IA engineer can spend up to 3 months at UCLA collaborating with Faculty Liaison
Industry Sponsored Seminar Day: Example

Mechanical & Aerospace Engineering Department Fall Seminar Series

Advances in Engineering at Boeing-Rocketdyne

Schedule for Boeing/ Rocketdyne visitors
Thursday, December 6, 2001

11:30 - 12 Arrival at Prof. Ann Karagozian's office (46-147K Engr. IV)

12 - 1:30 Luncheon at Faculty Center Sequoia 3 with MAE faculty

1:30 - 2:00 Overview of MAE Department: Chair D. L. Mingori (37-124 Engr. IV)

2:00 - 2:30 Lab tour, Prof. Carman – 32-138 Engr. IV

2:30 - 3:00 Lab tour, Prof. Karagozian – 1805 BH

3:00 - 3:30 Lab tour, Prof. M'Closkey – 33-138 Engr. IV

3:30 - 4:00 Seminar preparation - Engineering IV 47-124

4:00 - 5:30 Seminar - Engineering IV 47-124

5:30 - 6:30 Pizza party and recruitment activities
This seminar will be given by senior technical staff members and managers from the Aerospace Corporation (El Segundo). The scheduled topics are:

**Nanosat On-Orbit Dynamics**
**Space Vehicle Reentry and Breakup**

Other members of the Aerospace management and technical team will be on hand for informal discussions on recent advances in engineering technologies in the areas of Guidance and Control of Launch Vehicles and Satellites, Propulsion, Aero/Fluid Dynamics, Flight Mechanics, Structural Mechanics, Design & Verification of Launch Vehicle and Spacecraft Structures, and Ultra-tight GPS-IMU Coupling.

For more information, please contact the MAE Department (X45167) or Professor Ann Karagozian (X5563 or ark@seas.ucla.edu)
MAE Industrial Relations Activities, 2001-2

- Rocketdyne Seminar Day, Dec. 6, 2001
- MAE Industrial Advisory Board Meeting, Feb. 1, 2002
- Boeing Phantom Works Directors’ Mtg, April 16, 2002
- MAE Research & Technology Review, May 10, 2002
MAE Industrial Relations Activities, 2008-9

- MAE Industrial Advisory Board Meeting, Nov. 21, 2008
- Company X Seminar Day, ??
- Company Y Seminar Day, ??
- Company Z Seminar Day, ??
- Industry Panel Discussion on Aerospace/ Defense ??
- Industry Panel Discussion on Energy Issues, ??
- Schoolwide Technology Forum, April 23, 2009
Aerospace Corporation
Wayne Goodman
Gen. Manager, MILSATCOM

Air Force Research Laboratory
Shawn Phillips
Deputy Chief, S&M Propulsion Edwards AFB

Boeing Phantom Works
Jason Hatakeyama
Director, Structures Technology

Crocker Capital
Asad Madni
Former President, BEI Tech.

Honeywell Engines, Systems & Services
Roger Murry
Chief Engineer, Env. Control Systems

Intel
Gaurang N Choksi
Manager, Core Competency Devel.

Jet Propulsion Laboratory (NASA)
Dan Goebel
Senior Research Scientist

Lockheed-Martin Aeronautics
Philip Conners
Engr. Site Director, Skunk Works

NASA Dryden Flight Research Center
Kevin Peterson
Center Director

Northrop-Grumman Integrated Systems
Gary Ervin
Vice President, Air Combat Systems

Northrop-Grumman Space Technology
Geoffrey Turner
Manager, Thermal-Structural Design*

Pratt & Whitney - Rocketdyne
James Paulson, SSME Prog. Manager
Munir Sindir, Chief Engr., Calif. Ops.

Rand Corporation
Mrs. Natalie Crawford
Senior Fellow; Fmr. Head, Proj. Air Force

Raytheon Electronic Systems
Patrick Fitzgerald
Sr. Manager, Airborne Systems
We value your input and contributions to our department, faculty, and students

Thank you on behalf of the people of California and the nation!
Design Build Fly
The Blue Bearons

Gaurav Bansal
November 21, 2008
What is Design Build Fly?

- **Students:**
  - design an RC airplane to accomplish a prescribed set of missions
  - manufacture their design
  - fly the finished aircraft at the competition

- The contest will provide a real-world aircraft design experience for engineering students by giving them the opportunity to validate their analytic studies.
Requirements:

- Aircraft must be capable of carrying one 4 liter (1 gallon) bottle of water and 4 Estes rockets
- Must fit within two 2x2x4 boxes
- 100ft maximum take-off distances
Missions and Scoring

- **Missions:**
  - **Speed mission:**
    - Two laps with no payload with a score determined by: \( \text{SCF}/\text{FlightTime} \)
  - **Surveillance mission:**
    - must fly four laps with a full tank, score determined by: \( \text{SCF} \)
  - **Store Release/ Asymmetric Loads:**
    - Start with 4 rockets, drop 1 rocket per lap score: \( \text{SCF}/\text{LoadTime} \)

- \( \text{SCF} = 1/(\text{AssemblyTime} \times \text{TotalWeight}) \)
- \( \text{SCORE} = \text{WrittenReportScore} \times \text{TotalFlightScore} \)
# Team Organization

**Project Manager:** Gaurav Bansal  
**Design Advisor:** Jerry Huang

<table>
<thead>
<tr>
<th>Structure</th>
<th>Aero</th>
<th>Prop/Elec</th>
<th>Payload</th>
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<tbody>
<tr>
<td><strong>lead</strong> Scott</td>
<td><strong>lead</strong> Clarence</td>
<td><strong>lead</strong> Alex</td>
<td><strong>lead</strong> Eric</td>
</tr>
<tr>
<td>Song Z.**</td>
<td>Michael L.</td>
<td>Brian S.</td>
<td>Karen D.</td>
</tr>
<tr>
<td>Brian A.**</td>
<td>Charles J.</td>
<td>Matthew P.</td>
<td>Sung P.</td>
</tr>
<tr>
<td>Jennifer S.*</td>
<td>Alex Yu.**</td>
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<td>Nathanael P.*</td>
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<td>Thomas W.</td>
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</table>

* denotes undergraduate role; ** denotes graduate role; Song Z., Michael L., and the others are undergraduate roles; Jennifer S. and the others are graduate roles.
2008-09 Budget Overview

**Expected Expenses**
- Competition Required (Payloads)
- Materials (Structures)
- Materials (Electronics)
- Materials (Boxes)
- Tax/Shipping
- Tools
- Transportation (Car Rental)
- Transportation (Hotel)

**Sponsors**
- Boeing
- UCLA SEAS
- Engineering Alumni
- Solidworks

For Information for sponsoring UCLA AIAA DBF, please contact me

E-mail: gbansal@ucla.edu
Analysis

- Numerical Analysis
  - Computation Fluid Dynamics
  - Stability Calculations (AVL)

- Hands on Analysis
  - Proof of Concept prototype
  - Test different configurations for fastest time
  - Have a month to flight test completed design and optimize for maximum score
Institute for Technology Advancement (ITA)

Accelerating technology transition.

Presentation MAE IAB
November 21, 2008

Derek Cheung
dcheung@ita.ucla.edu
ITA Mission

• Identify and influence early stage, high value “discovery” research at UCLA and facilitate further development and transition to industry (existing or new) to maximize economic impact.

Institute Goals
1. Focus on “turning the corner” of the S-curve for UCLA technologies
2. Increase multi-disciplinary research funding at UCLA
3. Achieve cash-flow neutral operation

Discovery research >>> Products / markets
ITA Status

- Operational since February, 2008
- ITA is a part of UCLA’s School of Engineering & Applied Science
- Made possible by support from
  - Henry & Susan Samueli Foundation
  - Abraxis-Bioscience (CEO - Patrick Soon-Shiong, MD)
- Eight senior staff (2 full-time and 6 part-time)
- Two locations
  - Off-campus Headquarter
    • 4503 Glencoe, Marina del Rey
  - On-campus office
    • #6713 Boelter Hall
- Website: www.ita.ucla.edu
ITA Staff Role

1. Proactively work with faculty to identify key technologies
2. Develop business & funding opportunities
   - Transition research
   - Spin-outs
   - R&D support to industry
3. Manage projects and facilitate transition
ITA Operational Process
- Full Spectrum Tech-Transition Service

1. Transition Research
   - Build business case
   - Obtain funding (ITA, Gov., Ind.)
   - Demo. Feasibility (technical/market)

2. Spin-Off
   - Major opportunities (NewCo)
   - Niche business (SmallCo)

3. Other sources

4. Short term R&D Support to industry
Accomplishments (11/08)

**Spin-Outs**
- Bio-Chemical synthesis of chirally pure drug precursors & drugs
- Power Amplifiers for base station
- UCLA Applied Software Store
- RF interconnect

**Transition Research**
- Formulating major thrusts:
  - Battery & Energy Storage
  - Smart Power Grid
  - Information assurance & data security
  - Photonic Nanoscope technologies

**Other accomplishments:**
- New IP rights for industry sponsored R&D
- Search tool for HSSEAS tech capabilities
- Gevo
- Spirit
- Multiple SBIR contracts
- Visit to Major SC companies
Potential interaction with Industry

1. **Transition research partner**
   - Joint bid to mature an UCLA technology
   - Industry partner as a co-developer and recipient of UCLA technology when demonstrated

2. **R&D partnership**
   - Industry bid programs with UCLA(ITA) as a subcontractor
   - Industry directly fund UCLA(ITA) for specific needs, and get preferred IP position
ITAITA’s “New” IP Agreement for Industry sponsored research (approved by UCLA)

• Background

- SPONSOR has devised a Statement of Work (“SPONSOR Statement of Work”) and desires to engage ITA and Principal Investigator XXXX to conduct certain limited research at University’s facilities (“RESEARCH”).
- SPONSOR has existing Intellectual Property (“Sponsor’s IP”), in the form of patented technology which it wishes ITA to use in order to perform Sponsor’s Statement of Work. SPONSOR will pay full cost of the RESEARCH, including direct and indirect costs, currently 54%.

• Terms

- The sponsored RESEARCH, which requires University’s unique expertise and furthers University’s mission of research, education, and public service, will follow the attached Sponsor’s Statement of Work.

- Intellectual Property Rights: SPONSOR will receive title to any intellectual property that:
  (i) directly improves SPONSOR’s IP,
  (ii) is dominated by SPONSOR’s IP, and
  (iii) is conceived & reduced to practice under the direct performance of the project

- Professor XXXX will have the right to publish any of the work conducted during the sponsored RESEARCH, provided that SPONSOR is given 30 days advance notice to remove any confidential information. SPONSOR shall also have the ability to delay publications an additional 30 days to secure intellectual property rights.
ITAR Research

• Status:
  – ITA has petitioned twice to UCOP (UC Office of President) for limited waiver of ITAR restrictions for research carried off-campus at ITA
  – Petition denied based on principles of
    • Freedom of publication
    • Non-discrimination based on citizenship
    • Protection of “Safe-Harbor” status
  – Not likely to change
  – Need other options
ITAR Options

1. De-couple ITAR restricted information from programs; only conduct the non-ITAR portion on campus
   – Need contractor and sponsor concurrence

2. Encourage sponsor to use “Contracted Fundamental Research” designation for 6.1 and 6.2 funded research on campus
   – Exempt from ITAR restrictions

3. Wait for Augustine report implementation in Washington, but when and what?
Conclusion

• ITA’s role is to enhance UCLA’s
  – Tech transition process
  – Interaction with industry

• ITA is an experiment
  – Many new operational concepts
  – But success is not yet proven

• Looking forward to work closely with industry
  – Schedule ITA visit to your company
  – Think of UCLA/ITA when you bid a program

Thank you!
# ITA Core Staff (Tech. Strategist)

## Technology Expertise

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<tr>
<td>Derek Cheung</td>
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<td>DoD, Industry</td>
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<tr>
<td>Les Lackman</td>
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<tr>
<td>Andy Abele</td>
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<td>Federal &amp; State</td>
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<tr>
<td>Neven Karlovac</td>
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<td>NIH, VC</td>
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<td>Phillip Duncan</td>
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<td>Industry</td>
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## Experience and Education

<table>
<thead>
<tr>
<th>ITA Tech Staff</th>
<th>Education</th>
<th>Career</th>
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<tbody>
<tr>
<td>Derek Cheung</td>
<td>Ph.D, EE (Stanford)</td>
<td>Fairchild semi; Rockwell Scientific, MTS/Dir./VP/Pres. &amp; CEO</td>
</tr>
<tr>
<td>Les Lackman</td>
<td>Ph.D, CE (USC)</td>
<td>Boeing/Rockwell, VP/GM; B-1B program Mgr, UCLA-HSSES</td>
</tr>
<tr>
<td>Andy Abele</td>
<td>BS Engr (UCLA), MS (Caltech)</td>
<td>Exe. Dir, Quantum FST; Manager, SCAQMD; Energ/Env. Res. Corp</td>
</tr>
<tr>
<td>Neven Karlovac</td>
<td>Ph.D, EE (U. of Tenn)</td>
<td>VP LARTA; CTO, Fiberspace; CEO Accuwave, EVP Alcatel</td>
</tr>
<tr>
<td>Ira Deyhimy</td>
<td>BS. Phys. (UCLA), MS (CSUN)</td>
<td>Founder &amp; CTO, Vitess Semi; researcher, Rockwell SC, Litton MTS, JPL; Pres. Sega.com; Convergent VC, Genefluid, ORFID</td>
</tr>
<tr>
<td>Winn Hong</td>
<td>BSAE, MSME(UCLA), MBA (Chicago)</td>
<td>Founder &amp; CTO, Vitess Semi; researcher, Rockwell SC, Litton MTS, JPL; Pres. Sega.com; Convergent VC, Genefluid, ORFID</td>
</tr>
<tr>
<td>Wei Kao</td>
<td>Ph.D, Mat. Sc. (Mich. State)</td>
<td>Founder &amp; CTO, Vitess Semi; researcher, Rockwell SC, Litton MTS, JPL; Pres. Sega.com; Convergent VC, Genefluid, ORFID</td>
</tr>
<tr>
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<td>Ph.D. EE (UCLA)</td>
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Space Propulsion Research at UCLA

Richard Wirz
Assistant Professor
UCLA Mechanical and Aerospace Engineering
wirz@ucla.edu

Industrial Advisory Board Meeting
21 November 2008
Outline

- Academic and Industrial Experience
- Research Areas
  - Micropropulsion
  - Ion Thrusters
  - Propulsion/Spacecraft Integration
  - Alternative Energy
- Space Curriculum at UCLA
Academic and Industry Experience

- Virginia Tech
  - B.S. Aerospace, B.S. Ocean Engineering
- NASA Langley
  - ISS and Space Exploration
- SeaSun Power Systems
  - Ocean and Alternative Energy
- Gibbs & Cox, Inc.
  - Ocean and Alternative Energy
  - Navy Ships “Electric Propulsion”
- Caltech
  - M.S., Ph.D. Aeronautics and Applied Sciences
    - Dissertation “Plasma Processes of Ring Cusp Ion Thrusters”
- NASA/JPL
  - Advanced Propulsion Group “Electric Propulsion”
  - Climate Change and Energy Committee
- Alternative Energy Consulting
  - Solar and Wind Energy
Wirz Research Group
Space Propulsion and Alternative Energy

Grad Students:
Jack Young, Hann-Shin Mao,
Sebastian Aspe, Samuel Araki

Research Objectives in Space Propulsion: – Combine experimental and computational techniques to investigate advanced space propulsion concepts and the fundamental mechanisms of these systems

**Experimental Research**

**Electric Propulsion:** investigating the limits of thruster and component miniaturization and precision

**Computational Research**

**New cathode technologies**

- Modeling plasma “fluid” of electric thrusters
- Thruster/spacecraft interaction modeling
- Ion trajectory and thruster life modeling

**Research Objectives in Alternative Energy:** – New concepts in solar, wind, and ocean energy technologies

- Self-heated plasma cathode
- Plasma cathode with 5 W heater power
- Impulse bit < 1 µN•s
- 3-degree-ship pitch
Micro Electric Propulsion

- Rapidly emerging branch of advanced propulsion
- Microspacecraft
- Spacecraft control

IC Cathode

Richard Wirz, UCLA MAE - 5
MiXI - the **Miniature Xenon Ion Thruster**

- **Compact, lightweight configuration**
  - 200g
- **Designed for:**
  - Discharge optimization
  - Life validation
  - Cathode/Grid assembly testing
- **Baseline thruster for TPF-I**
Thrust vs. Equivalent Mass

**THRUST**

- Space Shuttle Main Engine
- Lunar Lander Engine
- Human Body
- Television
- Hall & Ion Thrusters

**EQUIVALENT MASS**

- 1 MN (1,000,000 N)
- 100 kN (100,000 N)
- 10 kN (10,000 N)
- 1 kN (1,000 N)
- 100 N
- 10 N
- 1 N
- 100 mN (0.1 N)
- 10 mN (0.01 N)

**Technology Gap**

- Miniature Ion Thruster
- Pulsed Plasma Thruster
- Cold Gas Microthruster
- Vaporizing Liquid Microthruster
- Electrospray Thrusters
- Solar Pressure on a Chewing Gum Wrapper
- Laser Ablation Thruster
- Grain of Pollen

**MICROPUSPULSION**

- 1 MN (1,000,000 N)
- 100 kN (100,000 N)
- 10 kN (10,000 N)
- 1 kN (1,000 N)
- 100 N
- 10 N
- 1 N
- 100 mN (0.1 N)
- 10 mN (0.01 N)

**Mockup**

- 100 mg (0.1 g)
- 10 mg (0.01 g)
- 1 mg (0.001 g)
- 100 µg (0.00001 g)
- 10 µg (0.00001 g)
- 1 µg (0.000001 g)
- 100 ng (0.0000001 g)
Exoplanet Finding

- Extreme precision requirements
  - Pointing
  - Precision Formation Flying
- Low noise
- Low contamination
- Thrust in sub-mN to mN range

Biosignatures

Richard Wirz, UCLA MAE - 8
TPF - Science Phase Propulsion

• Deployment
  – Initial deployment of spacecraft into science formation from cruise stage “stacked” configuration
  – Minor one-time ΔV

• Formation Flying
  – Retargeting
    • Position formation to view target
    • Acquire desired formation baseline
  – Spin-up
    • Initiate formation rotation
  – Fine Target Acquisition
    • Perform precise pointing maneuvers to attain target interferometer
  – Observation
    • Formation rotation
    • Maintain precise pointing
Propulsion Subsystem Design

- Four thruster pods per spacecraft
  - Five thrusters per pod
    - Provides formation and spacecraft control
    - Tolerant to thruster loss
  - Four neutralizers per pod
    - Required for 10-year mission life
    - No more than 2 neutralizers required (per pod) to operate during thrusting

- Thruster pod design characteristics:
  - Single fault tolerance for power and flow control authority
  - Single-strand XFC
  - PPU and XFCs are located near thruster pods

### Thruster Pod Schematic

| PPU 6 | | Ion Thrusters |
|-------|------------------|
| PPU 1 | XFC 1 | T1 |
| PPU 2 | XFC 2 | T2 |
| PPU 3 | XFC 3 | T3 |
| PPU 4 | XFC 4 | T4 |
| PPU 5 | XFC 5 | T5 |
| N-PPU 1 | XFC 6 | Neutralizers |
| N-PPU 3 | XFC 7 | |

PPU – Power Processing Unit
N-PPU – Neutralizer PPU
XFC – Xenon Flow Controller

Note: Not to scale

Approximate pod locations (Collector)

Xenon Supply (from central supply tank)

Terrestrial Planet Finder Interferometer - Emma Design Study
April 2, 2007
Spacecraft Plume Interaction

Thrust Direction

• Minimize interaction by only firing 45° canted thrusters into formation interior
  – Combiner ~ 1200 m away, must investigate optical contamination
• In-plane thruster is used only for centripetal force thrust
  – thus minimizing inter-spacecraft plume interaction
EP Mission Classes

High ΔV space missions
- DAWN

Low-disturbance station keeping
- MBSAT

Precision spacecraft control
- TPF-I
- LISA
- SIM
- GRACE Follow-on

Precision Earth Observing Missions such as InSAR

Richard Wirz, UCLA MAE - 12
Ion Thruster Research

- Experimental investigations of ion thrusters from 3 – 60cm
  - Thruster Development
  - Modeling
  - Life-testing
- Integrated experiments and computational modeling

MiXI = Miniature Xenon Ion
XIPS = Xenon Ion Propulsion System
NSTAR = NASA Solar Electric Propulsion Technology Application Readiness
NEXIS = Nuclear Electric Xenon Ion System
Ion Thruster Processes
DC Ring-Cusp

- Permanent magnet rings
- Magnetic Field Lines
- Propellant source
- Electron source

Discharge Chamber

High Velocity Ion Beam

Ion Optic Grids

Richard Wirz, UCLA MAE - 14
Grid Erosion

Accel Grid Erosion is caused by Charge Exchange (CEX) ions created in beam.

Richard Wirz, UCLA MAE - 15
JPL’s Extended Life Test (ELT) observed significant opening of the holes pits worn all the way through the NSTAR accel grid after 30,352 hours.

*This is a concern for high delta-v missions*
Grid Erosion Simulation

Min Erosion (TH0)
Test Segment 5

Chamfer Erosion (TH5)
Test Segment 6

15,684 hrs

Chamfer Erosion (TH5)
Test Segment 7

22,723 hrs

25,729 hrs

30,912 hrs

ELT

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Exploring the Asteroid Belt: The Dawn Project

- UCLA, JPL, Orbital collaborated to design and build the DAWN spacecraft

- The Gamma Ray and Neutron Detector (GRaND) provided by Los Alamos National Laboratory
- The Visible and Infrared (VIR) mapping spectrometer provided by the Italian Space Agency
- The Framing Camera (FC) provided by Germany.
CEV Retrorockets

- Flow fields show:
  - Fountain upwash
  - Wall jets
  - Recirculation
CEV Ground Effects
Plume/Body/Ground Interaction

- **“Thrust-gain”**
  - Caused by a “fountain flow” between plumes
    - Requires multi-plume interaction
- **“Thrust-loss”**
  - High velocity plumes entrain the local ambient air
  - Increased velocity of local air induces a pressure drop across the CEV underside
  - Recirculation and wall jets increase entrainment of local air
    - Thus, thrust-loss can be increased by ground
Future Research: Micropropulsion

- Requires Experimental and Computational research
- MiXI
  - Develop grids for 10 year mission
  - Demonstrate efficient miniature cathodes
  - Improve overall performance
  - Demonstrate repeatable precision
- Pulsed Plasma Thrusters
- Electrospray (FEEPs, Colloids)
Future Research: Electric Propulsion

- Thruster processes
  - Improve performance
  - Extend life
- Cathode technologies
- Spacecraft integration
  - Plume diagnostics/modeling
  - Electromagnetic field interactions

Richard Wirz, UCLA MAE - 22
Basic Research Topics

- Partially ionized plasma diffusion
- Dusty plasma cross-field transport and charging
- Low-energy xenon sputtering of materials
- Microfluidics for small flow systems
UCLA MAE Space Curriculum

- **MAE 161a, Intro to Astronautics**
  - Orbital Mechanics, Mission/Orbit Types, Space Environment

- **MAE 161b, Space Technology**
  - Space Systems and Technology

- **MAE 161c, Spacecraft Design**
  - Mission Design, System Engineering
Alternative Energy Research

• Wind Energy
  – Advanced blade design
  – Design for retrofit blades

• Solar Thermal
  – Thermal management and storage

• Recently started the UCLA Climate Healers Campus Club
  – 1st Campus Club for the Organization!
Thank you 🙂

Contact: wirz@ucla.edu
The HSSEAS Online Program
Current Status
Future Plans

Christopher S. Lynch
November, 2008
Overview

- Status of the program
  - Organization
  - MS Program Description
  - Enrollments
  - Companies represented
  - Financial

- Future Plans

- Discussion and feedback requested
MS Online Organization

MS Online Director, CS Lynch (program oversight and development)

- SAO, S. Revoner
  student advising, scheduling professors, TAs, exams, etc.

- Admin Asst. Caleb Bohannon
  interacts with applicants, e-mail, literature, schedule site visits, etc.

- IT professional, Felipe Kuo
  maintain studios, equipment, handle equipment updates, purchases, faculty needs

Seasnet Support Director, J. Austin

- Orachat Chiu
  Equipment, scheduling, programming, courseweb

- Rex Lorenzo (50%)
  Equipment, scheduling, programming, courseweb

- Felipe Kuo
  reports to Seasnet (50%)

Area Directors

- Year 1:
  Mech. Structures (A. Mal)
  Sig. Proc. & Comm (M. Gerla)
  Mfg. & Design (D. Yang)
  Comp Networking (K. Yao)

- Year 2:
  Mech. Structures (A. Mal)
  Sig. Proc. & Comm (M. Gerla)
  Mfg. & Design (D. Yang)
  Comp Networking (K. Yao)
  Electronic Materials (Y. Xie)
  Integrated Circuits (D. Markovic)
  *Systems Engineering (Yr 3)
Program support staff

- Full-time SAO Shanna Revoner dedicated to the online program.
- Full-Time, communications Caleb Bohannon
- Jan Labuda still providing help as needed.
- IT Rex Lorenzo, Felipe Kuo
The Nine Course Program

- Eight lecture-style courses
- One individual-study project course
- One course available per quarter including summer.
- Designed to be completed in 2.25 years
Areas offered

- Mechanics of Structures
- Advanced Structural Materials
- Manufacturing and Design
- Signal Processing and Communications
  - Radar systems
  - Multimedia systems
  - Communication systems (Satellite and Coding; and Networking)
- Integrated Circuits
- Electronic Materials
- Computer Networking
- Systems Engineering (planned Fall 2009)
  - See MSENROL@SEAS.UCLA.EDU for course offerings
Fall 2007, Cohort 1

- 79 students enrolled fall 2007

![Bar graph showing enrolled students in different fields: Mfg, CS Nets, SP Comm, Mech.](image)
Cohort 1, Year 2, 60 students remain.
Fall 2008 applicants: 122

83 accepted, 39 denied
2007 companies

First Quarter Enrollment

- Northrop
- Boeing
- Raytheon
- Edwards AFB
- Skyworks
- Lockheed
- Everyone Else
Industry Outreach

- MSOL Director available to present at companies
  - Lockheed Education Fairs June 2008
  - NGC visit May 2008
  - NASA Dryden newsletter to employees June 2008 with follow up visit
  - Discussions with Qualcomm
  - Area directors and faculty visit companies
Future

- **Immediate future**
  - Completing studios and offices in 7440 BH
  - Completed hiring of IT and Admin personnel
  - Introduce Systems Engineering track

- ** Longer term goals**
  - Build enrollments to 30+ per class
  - Expand infrastructure for recording lectures
  - Moving into international arena
Discussion items

- Admissions: 3.0 UG GPA plus letters
- Alternative:
  - Take 3 courses through UNEX with min grade of B+
  - Use those grades for the following year admission
- Designated degrees
  - Currently MS Engineering, not MSME, MSEE
  - Possible to transfer to ME for MSME
- Does this program meet industrial needs?
- Other comments?
UCLA Supermileage
MAE Department Industrial Advisory Board meeting
Friday, November 21, 2008
Project Leader: Jordan Chase
Past Project Leader: Brett Rosenthal
What is Supermileage?

- We design and build a single-person, lightweight vehicle that will obtain the highest possible fuel efficiency. During one competition year the team will design, fabricate, test, and compete at:

  - Shell Eco-marathon Americas (Fontana, CA)
  - SAE Collegiate Design: Supermileage (Marshall, MI)
Results

- 2006
  - SAE Supermileage: 18th place of 29 teams with 248 mpg
- 2007
  - Shell Eco-Marathon Americas: 8th place of 22 team with 824 mpg
  - SAE Supermileage: 6th place of 13 teams with 832 mpg
- 2008
  - Shell Eco-Marathon Americas: 13th place of 29 teams with 407 mpg
- 2009
  - Our goal is +1000 mpg
The Design

- Chassis
  - All Aluminum tubing
  - Optimized using FEA
- Engine
  - Custom made electric fuel injection
- Controls
  - Rack & pinion steering
  - Hydraulic brakes
- Fairing
  - Fabricated in house, all carbon fiber
  - Optimized using CFD
2009 Team

Jordan Chase
Project Leader

Philippe Gerretsen
Assistant Project Leader

We have also recruited 10 lower classman that have recently joined the project

Jon Ho
Electrical and Fairing Sub Assembly Leader

Adam Kellada
Engine Sub Assembly Leader

Brett Rosenthal
CAD Guru
The Team and The Objective

The Team – 25 student members

- Victor Reznikov – Project Manager
- Vishal Parikh – Project Manager
- Loren Prendergast – Propulsion Lead
- Nathan Reynolds – Structures Lead
- Professor Wirz – Faculty Advisor

The Objective

- To obtain hands-on experience in rocketry by applying theoretical concepts to practical design
Last Year’s Rocket

- 96” Tall
  - 4.5” ID
- Carbon Fiber Frame
- Commercial Engine
- Deployable Payload
  - GPS, Altimeter, Video Camera
Last Year’s Competition

• Experimental Sounding Rocket Association

• Primary objective
  • 10lb payload to 10,000 ft

• Secondary objectives
  • Recovery of payload / rocket
  • Written report
  • Oral presentation
Results

- Five Universities Entered
  - ASU, Utah State, UCI, Missouri, UCLA
    - UCLA was the only first-year team

- 1st Place
  - 8100 ft
  - Recovery within 5 minutes of launch
    - Thanks to Raytheon
Current Goals

- 2009 ESRA Competition
  - Basic
    - Same as last year
  - Advanced
    - 25000ft
  - Dual Entry
    - Fiber glass
    - Carbon fiber
Current Goals

- Development of a hybrid engine
  - Current Research
    - Oxidizer, fuel, combustion, ignition, injection

- Reuse of carbon fiber frame
  - Structural improvements

- Development of fiber glass frame
  - Constrained to hybrid engine
Current Goals

- Improvement of Payload
  - Auto-rotation recovery

- Funding
Thank You
Dutch initiative to promote sustainable technologies worldwide

Hold international racing competitions between top universities

Why?
HERCUCLAS Beginnings
Mission/Goals

Who are we?

- Students, Engineers, Competitive Racing Team

What do we do?

- Design, Fabricate, Race

Why?

- Apply theoretical knowledge
- Hands-on experience
- Fun and excitement combined with eco-friendliness

Our Mission Statement:
To promote green technology by offering student engineers design and practical experience outside of class in a fast-paced, competitive racing environment.
Leadership

Our Advisors:

Our Team Leaders:

Jeff Jonokuchi  
AE  
Chassis Lead  
Fourth Year  
Undergraduate

Giacomo Po  
ME  
High Voltage Lead  
Graduate Student

Ibrahim Al-Shyoukh  
ME  
Low Voltage Lead Lead  
Post-Doctoral

Omar Sheikh  
CS  
Software Lead  
Fourth Year  
Undergraduate

Jorge Pena-Lopez  
ChE  
Safety Lead  
Graduate Student

Fernando Olmos  
ChE  
Hydrogen Lead  
Fifth Year Undergraduate
Kart Specs:
- Maxwell Supercapacitors (80V System)
- 70V 8KW Hydrogenics Fuel Cell
- Capable of 0-60mph in 6 seconds

Kart Safety Features:
- Triple Redundant Emergency Hydrogen Shutoff
  - Solenoid Valve (electronic)
  - Bleed valve (pressure sensitive)
  - Manual Shutoff Valve (driver accessible)
- Complete System shut down
  - Manual Kill Switch
  - Deadman Switch
  - Impact Sensors
Branding Plans:
- Create a marketable image to fit our mission

Fundraising Plans:
- Local Companies, government agencies, celebrities, UCLA

Publicity Plans:
- Press releases, Car Expos, alternative energy conventions, etc.
The First Race

Results: DNF

Insights: Home Field Advantage, Interaction Between Teams
Future Plans

Future Races
- 2008-09 Season: March, South Carolina; April, London

Rebranding
- PR team looking to update image, generate racing partnerships

Recruitment
- All engineering disciplines, marketing/econ majors, graduate students, UCLA community support
UCLA Mini Baja 2008-2009
Baja Design Challenge

- 10 hp Briggs and Stratton Engine
- Single Seat Dune Buggy
- Fully Enclosed Roll Cage
SAE Baja Competition

Static Events

- Design Judging
- Safety Inspection
- Sales Presentation
- Cost Score
SAE Baja Competition

Dynamic Events

• Maneuverability
• Rock Crawl
• Acceleration
• Hill Climb
• 4 Hour Endurance Race
2008 Accomplishments

- Best overall finish (35th out of 100)
- 10th place in Sales Presentation
- Finished Endurance Race
- $2000 under budget
2008 Shortfalls

- 50 point tech penalty
- Poor performance in rock crawl and maneuverability
- Problems During the Endurance Race.
2009 Mini Baja Car
2009 Mini Baja Car

Changes

• New Chassis
• Lighter Drive-train System
• Improved Dynamics
• Optimize subsystems
Fall Education Project (FEP)
Mars Rover and RoboMagellan

Andrew Boggeri
President
Robotics Club at UCLA

11 / 21 / 2008
The Robotics Club Would Like to Thank its Generous Sponsors
Club Information

- Membership and Vision
  - We currently have over 75 active members in the club, mostly Engineering majors but with a number of Liberal Arts students participating as well.
  - We are focused primarily on educating our members and bridging the gap between the abstract theory taught in the classroom and the real world challenges that engineers face. We do this through hands-on projects, seminars, and self-directed learning.
  - We have a comprehensive, year-long education plan for new members that takes them through two small projects to prepare them to work on a large competition-level system.
  - Our major goal is to become the premier source of hands-on, complex systems education at UCLA.
2008-2009 Goals - Fall

- Retain at least 20 new members
  - FEP is designed to strengthen the team by causing student to student interactions rather than me just standing at the front of the room talking. People stick around when they take ownership of a project or a part of a project
- Set up a training program for new members to prepare them to work on a large competition project
  - FEP has three components: Mechanical, Electrical, and Software. Each member is overseen by a team lead with at least some experience as well as participating in focused learning seminars/assignments in their area
- Improve our connections with industry
  - We want to create lasting relationships with our sponsors by placing large numbers of our members into internship programs
2008-2009 Goals - Winter

- Complete FEP
- Separate club into members ready to participate in competition project and members who need more experience
- Initiate Spring Educational Project (SEP)
  - Very likely a small-scale robot
    - Smaller bot saves money on parts
    - Forces mechanical engineers to consider weight-performance optimization (on the order of grams)
    - Keeping the software design simple will allow us to begin cross-training mechanical engineers in software
- Complete Mars Rover and RoboMagellan designs by 6th week
- All parts ordered for Rover and Magellan by the end of the quarter
Programs – Fall Education Project

- Fall Education Project
  - Autonomous, object-collecting robot
  - 5 teams of students
  - An “Introduction to Systems Engineering”
  - Each team is given a $400 budget, $100 contingency as well as access to raw materials and electronics the club already has
  - Competition to take place 4th or 5th week winter quarter
- STATUS:
  - Mechanical designs complete and frozen
  - CDR Thursday Nov 20
  - Software is a challenge because many new members aren't very experienced; to try and assist them we pushed the competition date back - but they don't know that yet ;)


We're leveraging Baja's experience with SolidWorks to train both teams' members in advanced design concepts. In return, we can help them if they implement any advanced electronics.
A major part of preparing students to work on a competition project is training them in the iterative design process.

- The FEP puts major constraints on budget and time to teach students how to maximize their design phase and engage as a team to achieve milestones.
- Team leads are introduced to public speaking and design reviews, where they must be able to qualify design choices with engineering principles rather than gut feelings.
- Design Reviews also serve to allow the leadership of the club to make sure everyone is on track to complete the project in time. Team members are also asked for feedback on their leads, allowing the leads to develop their leadership skills.

Pictures from the CDR on 11/20 follow.
Programs – University Rover Challenge

- Our bread and butter for the past 2 years
- Competition put on by the Mars Society and Raytheon
  - Held in Hanksville, UT (about 1-2 hours from Zion National Park)
  - Challenges teams to design and build a teleoperated, untethered rover to compete in a series of challenges:
    - Construction
    - Emergency payload delivery
    - Biological investigation of a target site
    - Geological investigation of a target site
- In 2008 we were forced to withdraw due to a catastrophic failure of our drivetrain. However, field testing showed our software setup to be far more reliable than the other teams'
Programs – SRS RoboMagellan

- Project we did ground work for last year
- Competition is to design and build a small, autonomous robot that must navigate an outdoor obstacle course and locate an orange cone
  - Competitions are held around the US
  - We will hopefully be competing in RoboGames this year
- Project is a “Mini-DARPA Grand Challenge” so it involves some very complex software aspects
- We have the base software (RoboServer Distro) complete, we need to add high-level logic and decision making capability
CDR Pictures – Following Slides

- Some pictures and graphics from the CDR on 11/20
Chassis CAD – Team 5
Team 1 Chassis CAD
Team 4 Chassis CAD
Team 5 with arena mapping test program
The End

• Any questions?
  • Visit us at http://www.seas.ucla.edu/robotics/
  • Or get in touch at ucla.robotics@gmail.com
  • We're always looking for new sponsors, so if you're interested in working with one of the largest and most dynamic UCLA Engineering Student Groups, please get in touch. Sponsors support us at all levels with parts and mentorship as well as cash.
What Our Team Does

- We are a team of UCLA students who design, build, and compete combat robots.

- The team is currently in its fourth year and growing very quickly, both in members and projects.

- Each year we take our robots to competitions to fight against other robots from all over the world.

- This year we are completely redesigning two existing robots and modifying two of our most successful robots from the previous year.
Design

• We start our design with just one criteria: weight, and our challenge is deciding how to allocate it to the drive train, armor, weapon, etc

• We make our design decisions trying to fit everything we need in as small a space as possible while maintaining a sturdy structure

• We computer model our robots to plan for the robots shape and possible inefficiencies that we could encounter down the road
- This is the heart of the operation.
- Our frame and armor are made from all stock materials fabricated to fit our purpose in the student shop.
- It's a great way for new members to learn their way around a real shop and to apply the theories of mechanical engineering.
WoodBot Project

- Introduces students to SolidWorks
- Teaches members how to use the machine shop
- Prepares them to create their own BattleBot
This Years Robots
DracUCLA

-Middleweight (120 lb) “Drum” Battlebot was built during the 2006-2007 school year

-Frame made of 1” steel tubing

-Being completely rebuilt for ESPN’s televised college competition
UB Ruined

- UBruined is our new (60lb) robot, built and competed entirely during the 2007-2008 school year.

- UBruined weapon is a 12lb S7 steel bar that spins at over 2200 RPM.

- Ubruined went 2-2 at RoboGames 2008, losing to the first place robot.

- Replaced gearbox components with high strength bolt and titanium washer.
Bruiner of Worlds

- Lightweight (60 lb) “Thwack” Battlebot was built during the 2006-2007 school year
- Spins up to 220 RPM
- Despite misaligned chain, went 2-2 at RoboGames 2008

- Ranked 15th in the nation
- Modified for increased battery capacity and chain alignment
UCLAsh

-Proposed Featherweight (30 lb) “Drum” Battlebot
Proposed Designs

Proposed 12lb “Push” BattleBot
Proposed Designs

Proposed 60lb BattleBot
Competing

- We bring our robots to competition after they are built and battle tested.
- The matches last three minutes and if no knockout occurs then the match is decided by a panel of judges.
- The competitions are double elimination and the matches are held in front of bleachers so that other builders and the adoring crowd can watch.
- It’s a great place to showcase design ideas and get new ideas for the next year of building.
- We extend an open invitation to all supporting faculty, alumni, and industry to attend RoboGames for good, clean, destructive fun (May 1\textsuperscript{st}-3\textsuperscript{rd}, San Francisco)

- RoboGames international competition
- ESPN televised college competition
Involvement With Corporate Entities

We currently have relationships with SolidWorks and a few other companies, and are actively looking for other additional corporations to become involved with, either with sponsorship or mentorship opportunities.
Questions

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