

THIRTY-EIGHTH ANNUAL PROJECTS DAY

The Computer Science, Engineering, Mathematics, and Physics Clinics of Harvey Mudd College are pleased to present the work of our students.

Robert Keller, Director
Computer Science Clinic

Patrick Little, Director
Engineering Clinic

Andrew Bernoff, Director
Mathematics Clinic

Richard Haskell, Director
Physics Clinic

Shenda Baker, Director
Global Clinic

HARVEY MUDD COLLEGE
PROJECTS DAY
May 6, 2008

Program

10:30 a.m.	Registration and Poster Viewing	Linde Activities Center
1:00 p.m.	General Session	Galileo/McAlister
	Welcome - Maria Klawe, President	
	Remarks - Patrick Little, Director Engineering Clinic	
	Milestone Awards - Robert J. Cave, Vice President and Dean of the Faculty	
	Recipients: The Aerospace Corporation Center for Integration of Medicine and Innovative Technology (CIMIT) Cardinal Health DIRECTV Inc. Sun Microsystems	
1:30 - 3:00 p.m.	Project Presentations	See Map (center page)
3:00 - 3:30 p.m.	Break	Hixon Court
3:30 - 5:00 p.m.	Project Presentations	See Map (center page)
5:15 - 6:00 p.m.	Poster Reception for Guests, Faculty, and Students	Linde Activities Center

Schedule of Presentations

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	
COMPUTER SCIENCE CLINIC							
Bluebeam Software, Inc. <i>A Web-Based PDF Management and Organization Solution</i>	X		X		X		J-B134
D4 Networks <i>A Web-Based Implementation of a Reservation and Scheduling System for Efficient Per-Seat Pricing for Air Taxi Service</i>		X		X		X	B-B105
Fair Isaac Corporation <i>Visualizing Proof Search</i>	X		X		X		Pryne
Microsoft Corporation <i>CPU and GPU Based Image Processing for Digital Photographers</i>		X		X		X	Pryne
QUALCOMM <i>FLO Analysis Tool (FLOAT)</i>	X		X		X		B-B105
RealNetworks, Inc. <i>Development and Characterization of a Real-Time Video Streaming System</i>		X		X		X	J-B134
ENGINEERING CLINIC							
9:Fish Surfboards <i>Riding the Green Wave: Eco-Friendly Surfboard Manufacturing</i>	X		X		X		P-1283
The Aerospace Corporation <i>Spaceborne Emergency Distress Beacons</i>	X		X		X		P-2375
AeroVironment, Inc. <i>Meteorological Payload for Small Unmanned Aerial Systems</i>	X		X		X		P-B181
Alejo Engineering, Incorporated <i>Coordination of the Safety and Mission Assurance (S&MA) Activities on the Crew Exploration Vehicle Program</i>	X		X		X		P-1277
Cardinal Health <i>Bubble Formation and Kinetics in IV Delivery Systems</i>		X		X		X	P-2383

Building Codes:

B = Beckman

J = Jacobs

P = Parsons

Edwards = Galileo-Edwards

McAlister = Galileo-McAlister

Pryne = Galileo-Pryne

Note: The “B” AFTER the hyphen in room numbers indicates “Basement Level.”

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	
Cardinal Health <i>Drug Verification for an IV System Using Spectroscopic Methods</i>		X		X		X	P-2375
Center for Integration of Medicine and Innovative Technology - CIMIT <i>Blast Armor Using Machine-Augmented Composite Material</i>		X		X		X	P-1283
CTG Energetics, Inc. <i>Campus Sustainability Database</i>		X		X		X	P-1275
DIRECTV Inc. <i>Field Portable Test Kit</i>	X		X		X		P-2383
Firestone Center for Restoration Ecology <i>Vertical Axis Wind Turbine for Remote Research</i>	X		X		X		P-1285
Honeywell Aerospace <i>Analysis of Two-Phase Flow in OBIGGS Distribution Systems</i>		X		X		X	P-B181
Lawrence Livermore National Laboratory <i>Optimizing a Water-Based Muon Detector</i>		X		X		X	P-1264
Los Alamos National Laboratory <i>Ultra-Low Magnetic Resonance Imaging System</i>		X		X		X	P-1277
Northrop Grumman Corporation <i>Creating a More Environmentally-Friendly Aerospace Industry: Lead-Free Design and Manufacturing</i>		X		X		X	P-1285
Opto 22 <i>Wireless I/O Commissioning System</i>	X		X		X		P-2358
Orthodyne Electronics <i>Develop & Validate a Mathematical Model of a Wire Bonder Structure for Use in the Development of Future Platforms</i>	X		X		X		P-B171
Raytheon Space & Airborne Systems <i>Satellite Payload Test Bed for Radiation Hardness Testing</i>		X		X		X	P-B171
Southern California Edison-Innovation <i>Acetylene Gas Monitoring in Distribution Transformers</i>	X		X		X		P-1287C
Southwest Research Institute <i>Balloon Borne Telescope</i>		X		X		X	P-2358
Space Systems/Loral <i>Low-Shock Solution for Satellite Solar Array Deployment</i>		X		X		X	P-1287C
SRI International <i>Ad-Hoc In-Building Tracking System</i>	X		X		X		McAlister
Sun Microsystems <i>Building Ships for Fleet</i>		X		X		X	McAlister
TREX Enterprises Corporation <i>Active Millimeter-Wave Imaging Using Fourier Telescropy</i>	X		X		X		P-2381

Project	Time					Location	
	1:30	2:00	2:30	3:30	4:00		4:30
KGI/ENGINEERING CLINIC							
Gilead Sciences <i>Automated Visual Inspection Project</i>	X		X		X		P-1275
MATHEMATICS CLINIC							
Beckman Coulter, Inc. <i>Modeling Bead-Based Immunoassays</i>	X		X		X		Edwards
Citadel Investment Group <i>Investigating Returns to Pairs Trading Strategies</i>	X		X		X		B-B126
Laserfiche <i>Automated Dewarping Algorithms for Enhancing Camera-Based Document Acquisition</i>		X		X		X	B-B126
WorldQuant, LLC <i>Efficient Stock Trading</i>	X		X		X		B-B134
PHYSICS/ENGINEERING CLINIC							
Harvey Mudd College-Physical Plant & Campus Planning Committee of the Board of Trustees <i>Guiding Sustainability at Harvey Mudd College</i>	X		X		X		P-1264
PHYSICS/MATHEMATICS CLINIC							
Southwest Research Institute <i>Modeling the Performance of a Jupiter-Bound Electron Sensor in Strong Magnetic Fields</i>		X		X		X	Edwards
GLOBAL CLINIC							
Applied Biosystems <i>Design, Building, and Validation of a Low-Cost Real-Time Polymerase Chain Reaction Instrument for Copying and Quantifying DNA</i>	X		X		X		P-1287B

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Computer Science

Bluebeam Software, Inc.
D4 Networks
Fair Isaac Corporation
Microsoft Corporation
QUALCOMM
RealNetworks, Inc.

Engineering

9:Fish Surfboards
The Aerospace Corporation
AeroVironment, Inc.
Alejo Engineering, Incorporated
Applied Biosystems (Global)
Cardinal Health
Center for Integration of Medicine
and Innovative Technology
(CIMIT)
CTG Energetics, Inc.
DIRECTVInc.
Firestone Center for Restoration
Ecology
Honeywell Aerospace
Lawrence Livermore National
Laboratory
Los Alamos National Laboratory
Northrop Grumman Corporation
Opto 22

Orthodyne Electronics
Raytheon Space & Airborne Systems
Southern California Edison -
Innovation
Southwest Research Institute
Space Systems/Loral
SRI International
Sun Microsystems
TREX Enterprises Corporation

KGI/Engineering

Gilead Sciences

Mathematics

Beckman Coulter, Inc.
Citadel Investment Group
Laserfiche
WorldQuant, LLC

Physics/Engineering

HMC-Physical Plant & Campus
Planning Committee of the Board
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Physics/Mathematics

Southwest Research Institute

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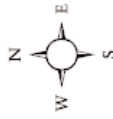
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Patrick Little, *Engineering*
Andrew Bernoff, *Mathematics*
Richard Haskell, *Physics*
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Personalized Projects Day Schedule

Please fill in the empty slots below with the presentations you would like to attend.

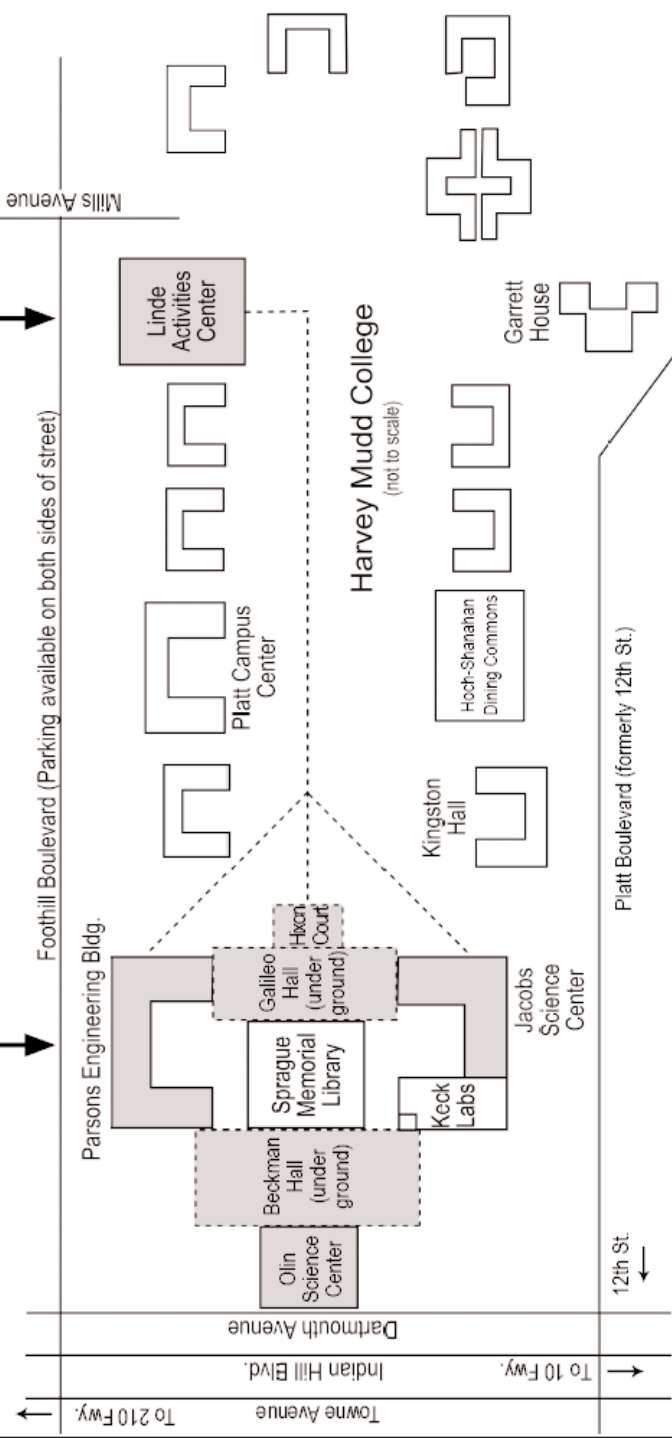
Time	Event	Location
10:30 a.m.	Registration and Poster Viewing	Linde Activities Center
1:00 p.m.	General Session	Galileo/ McAlister
1:30 p.m.		
2:00 p.m.		
2:30 p.m.		
3:00 p.m. - 3:30 p.m.	Break	Hixon Court
3:30 p.m.		
4:00 p.m.		
4:30 p.m.		
5:00 p.m. - 6:00 p.m.	Poster Reception	Linde Activities Center

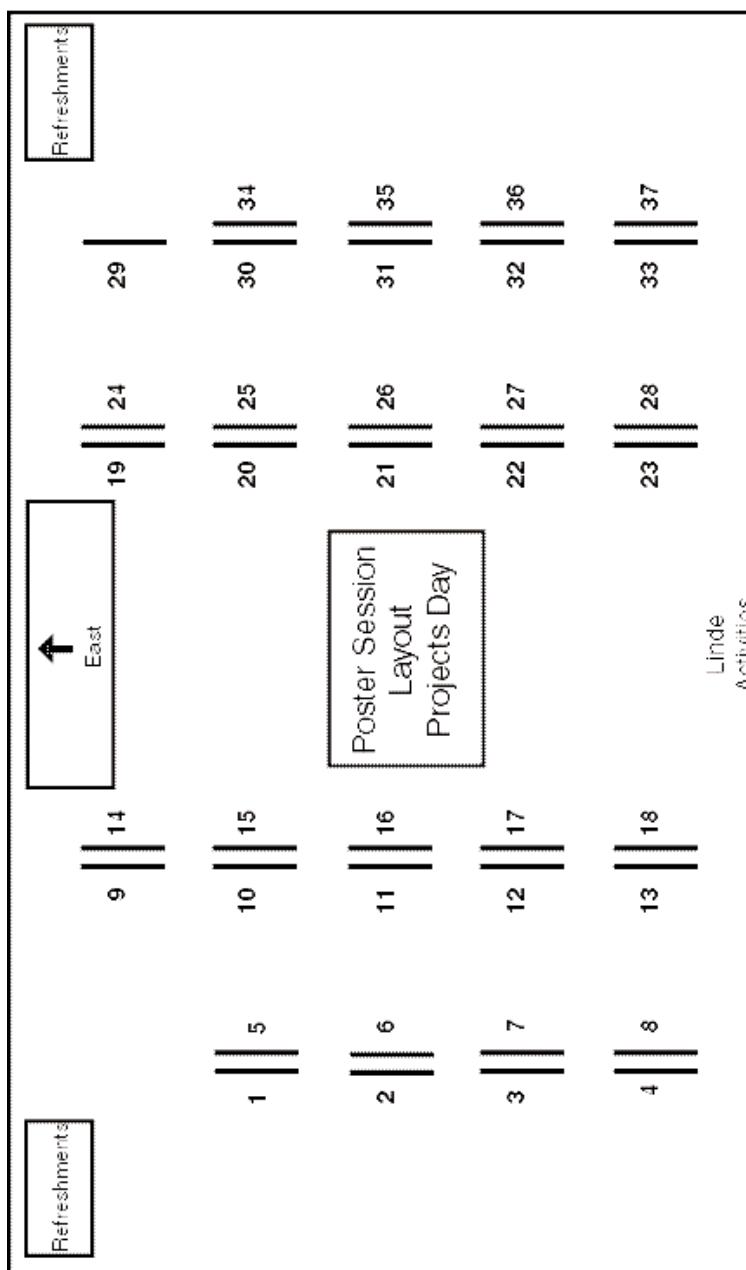


General Session 1:00 p.m.
Galileo Hall
Presentations 1:30 p.m. to 5:00 p.m.

Projects Day Campus Map

Registration & Poster Viewing for Projects Day
10:30 a.m. to 12:45 p.m.
Poster Reception
5:15 p.m. to 6:00 p.m.
Linde Activities Center

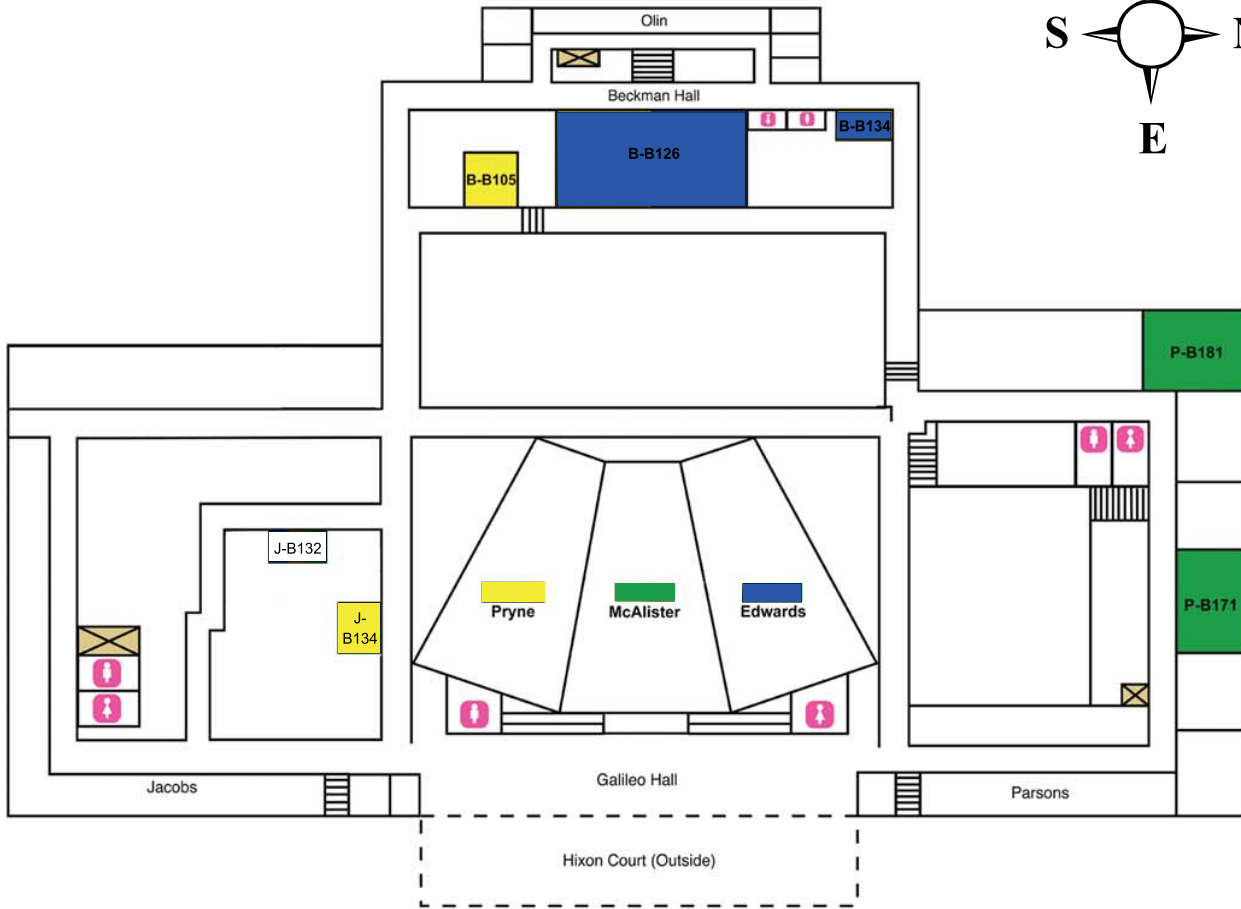
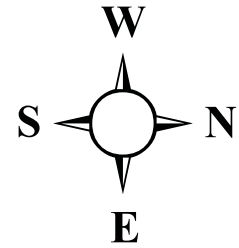




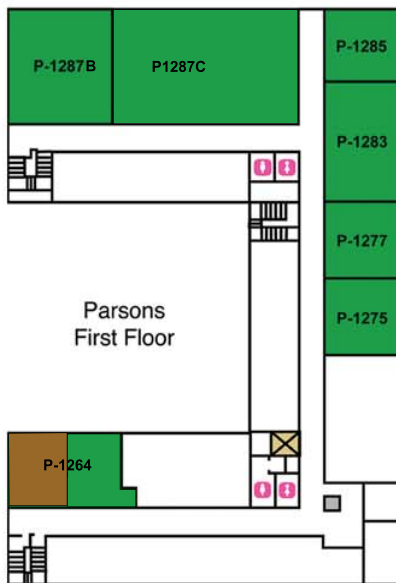
Key to Poster Session Layout

1. 9:Fish Surfboards
2. The Aerospace Corporation
3. AeroVironment, Inc.
4. Alejo Engineering Incorporated
5. Applied Biosystems
6. Beckman Coulter, Inc.
7. Bluebeam Software, Inc.
8. Cardinal Health-Bubble Dynamics in IV Systems
9. Cardinal Health-Drug Verification
10. Center for Integration of Medicine and Innovative Technology (CIMIT)
11. Citadel Investment Group
12. CTG Energetics, Inc.
13. D4 Networks
14. DIRECTV Inc.
15. Fair Isaac Corporation
16. Firestone Center for Restoration Ecology
17. Gilead Sciences
18. HMC-Physical Plant & Campus Planning Committee of the Board of Trustees Sustainability Clinic
19. Honeywell Aerospace
20. Laserfiche
21. Lawrence Livermore National Laboratory
22. Los Alamos National Laboratory
23. Microsoft Corporation
24. Northrop Grumman Corporation
25. Opto 22
26. Orthodyne Electronics
27. QUALCOMM
28. Raytheon Space and Airborne Systems
29. RealNetworks, Inc.
30. Southern California Edison-Innovation
31. Southwest Research Institute (ENG)
32. Southwest Research Institute (MATH/PHYSICS)
33. Space Systems/Loral
34. SRI International
35. Sun Microsystems
36. TREX Enterprises Corporation
37. WorldQuant, LLC

Projects Day Directory 2008



Basement Floor of Beckman, Galileo & Parsons



Legend

- Computer Science Clinic
- Engineering Clinic
- Mathematics Clinic
- Physics/Engineering Clinic
- Restrooms
- Stairs
- Elevator

First and Second Floors of Parsons

COMPUTER SCIENCE CLINIC

Bluebeam Software, Inc.

A Web-Based PDF Management and Organization Solution

Liaisons: Don Jacob, Richard Lee
Advisor: Christine Alvarado
Students: Jay Markello (PM), Eduardo Ruvalcaba, Joe Simmons, Scott Triglia

This Clinic team researched and developed a system to organize and manage large sets of PDF's (Portable Document File documents). The proposed system enables users to find the document they need quickly and efficiently by searching through data within the file and user supplied data about the file. The team measured the system's success by how much it simplifies the process of finding a particular file.

D4 Networks

A Web-Based Implementation of a Reservation and Scheduling System for Efficient Per-Seat Pricing for Air Taxi Service

Liaison: Chuck McKnett
Advisor: Zachary Dodds
Students: Andrew La Motte-Mitchell (PM), Chris Alvino, Corey Hebert, Steven Sloss

The goal of this project was to develop a web application highlighting the flexibility and convenience of charter air travel. This application enables passengers and charter operators to pool their resources in order to keep travel competitive with commercial airlines. The team's efforts enable an optimization algorithm from a 2006-7 HMC Math Clinic to act as an engine for a charter-booking and delivery business.

Fair Isaac Corporation

Visualizing Proof Search

Liaison: John Byrnes
Advisor: Robert Keller
Students: Mike Buchanan (PM-F), Michael Ernst, Phil Miller (PM-S), Chris Roberts

Fair Isaac deals with large knowledge bases in a variety of their lines of business. They are developing an automated theorem prover in the natural deduction framework to build on these data sets. The scale of the proofs and their attendant search spaces make textual proof display and analysis of the prover's operation unreasonable. Thus, the Clinic team has developed a visualization system which greatly eases development efforts. It provides a structured display of the theorem prover's search space and a programmable command-line interface which gives the developer significantly more flexibility than a conventional debugger would allow.

Microsoft Corporation

CPU and GPU Based Image Processing for Digital Photographers

Liaisons: Brad Hinkel '84, Eric Bennett
Advisor: Z Sweedyk
Students: Lucy Abramyan (PM), Morgan Conbere, Ellen Kephart, Lilia Markham, Matt McKenett

Through over a century of research and practice, professional film photographers developed visual aesthetics for compelling images, with "looks" pleasing to the human eye. These techniques are often at odds with the non-perceptual, analytical image processing algorithms applied to digital photographs today. This project examines how these worlds can be united by developing aesthetically-inspired algorithms and prototypes (on the CPU and GPU) for perceptual saturation enhancement, soft focus simulation, and locally-modified high-dynamic range image processing.

* "(TL)" Indicates Team Leader
"(PM)" Indicates Project Manager

QUALCOMM

FLO Analysis Tool (FLOAT)

Liaisons: George Joseph, Mark Storch, David Fischer

Advisor: Geoff Kuenning

Students: T. Andrew Glass (PM), Andrew Pienkos, Michael Roberts, Kris Karr (F)

MediaFLO is a mobile television technology that has been developed by Qualcomm. Since FLO (Forward Link Only) signals behave unpredictably when subjected to real-world conditions, it can be very challenging for engineers to diagnose issues with MediaFLO transmissions. Our project expedited this process by developing a series of applications that will aid in the collection and analysis of MediaFLO signal data while enabling communication between engineers in the field and in a central location.

RealNetworks, Inc.

Development and Characterization of a Real-Time Video Streaming System

Liaisons: Edmond Mesrobian, Amol Shukla

Advisor: Christopher Stone

Students: Thomas Barr (PM), Sameer Sontakey, Peter Mawhorter, Daniel Rozeboom

The team developed a live video delivery system that utilizes the upload capacity of clients in a peer-to-peer (p2p) system. While p2p systems have become popular for on-demand content delivery in recent years, no successful live streaming system has ever been deployed commercially. The team developed a novel system, and will fully test its behavior in a simulated network.

ENGINEERING CLINIC

9:Fish Surfboards

Riding the Green Wave: Eco-Friendly Surfboard Manufacturing

Liaisons: Sunny Trinh '92/93, Wesley Negus

Advisor: Lori Bassman

Students: Tom Donze (TL), Daniel Chen (S), Ross Scalfani (S), Tony Evans (F)

Modern surfboard manufacturing techniques involve polyurethane foam production and fiberglassing, processes that pose environmental and health risks. The surfboards produced are expensive, easily damaged, and have a short lifespan. 9:Fish Surfboards wishes to eliminate these drawbacks by designing a better surfboard. With a focus on material selection, a team of HMC students redesigned the manufacturing process to use more durable, recyclable surfboard components. The result of their work is a new surfboard that seeks to revolutionize the surfing industry.

The Aerospace Corporation

Spaceborne Emergency Distress Beacons

Liaison: Samuel S. Osofsky '85

Advisor: Sarah Harris

Students: Nathaniel Pinckney (S-TL), Howard Chen (F-TL), Andrew Danowitz, Andrew Giles, Michael Braly

The Aerospace Corporation has sponsored a project to design and build a spaceborne distress beacon add-on board for picosatellites. The design is capable of powering 18 3W LEDs using switching current regulators. The beacon is controlled by a microcontroller, which is triggered by external inputs. The beacon can flash the LEDs in pre-programmed patterns, such as Morse code. The design has been tested and found to operate to specifications. A standalone distributed wireless beacon design has also been developed.

* "(F)" Fall Semester
"(S)" Spring Semester

AeroVironment, Inc.

Meteorological Payload for Small Unmanned Aerial Systems

Liaisons: Dave Wilbur '68, Justin McAllister
Advisor: Donald S. Remer
Students: Michael Scott Kimbrell (S-TL), Jason Choi (F-TL), Richard Priddell (S), Michael Kai Mayeda (S), Michael Yang (F)

AeroVironment asked the HMC Clinic team to develop new sensor packages to expand the service of its unmanned aerial systems. The team produced a proof of concept for a meteorological sensor package. The package was designed to have minimum size and weight and to measure pressure, temperature, and relative humidity. After building the system, the team did wind tunnel testing on the proof of concept and field testing with a remote-controlled airplane to check the sensor data.

Alejo Engineering Incorporated

Coordination of the Safety and Mission Assurance (S&MA) Activities on the Crew Exploration Vehicle Program

Liaison: Todd Paulos '90
Advisor: Patrick Little
Students: Peter Wang (S-TL), Diana Hawkins (F-TL), Ben Bergstedt (F), Andrew Sabater (F), Scott Smith (S), Tim Sweda (S)

On typical aerospace projects, there are many different S&MA analysis, such as hazard analyses, Failure Mode Effects and Critically Analysis (FMECA), and Probabilistic Risk Assessment documents (PRAs). There has always been a need to coordinate the analysis, ensure that failure modes in one analysis are considered in the others, and that the data values are consistent. This project developed a software tool that will help coordinate failure modes and data assessed in the PRA, the FMECA, and hazard analysis.

* “(TL)” Indicates Team Leader
“(PM)” Indicates Project Manager

Applied Biosystems (Global)

Design, Building, and Validation of a Low-Cost Real-Time Polymerase Chain Reaction Instrument for Copying and Quantifying DNA

Liaisons: Adrian Fawcett, Ken Livak '74, Mark Oldham
Advisor: Shenda Baker
Students: Jeffrey Rubinstein (TL-HMC), Cedric Tan Kai Wei (TL-NUS), Jonathan Chen (HMC), Alexandria Kealey (HMC), Elizabeth Flannery (HMC), Chang Ci'en Sharon (NUS), Sui Xiaodi (NUS)

Our Global Clinic project was a collaboration between students at Harvey Mudd College and the National University of Singapore. The project was to design, build and validate, a low-cost scientific instrument for making copies of DNA and quantifying the amount of DNA during the copying process. Specifically, the project focuses on the development of the thermalcycler and the optical detection subsystems for this instrument whose intended users are students in US secondary schools.

Cardinal Health

Bubble Formation and Kinetics in IV Delivery Systems

Liaison: Bob Butterfield
Advisor: Anna Hickerson
Students: Rachel Howden (TL), Cassandra Cortez, Caitlin Vierra, Janet Komatsu (S), Chieh Chen (F), Lucia Cheung (F)

Air bubbles are one of the primary concerns with intravenous (IV) drug-delivery systems and cause problems ranging from inconvenience for pump operators to compromising the safety of the patient. The Clinic team conducted experimentation investigating the effect of various parameters on bubble formation and mobility. The goal of this project was to use experimental findings to develop an improved IV design that minimizes air bubbles within the system.

* “(HMC)” Harvey Mudd College
“(NUS)” National University of Singapore

Cardinal Health

Drug Verification for an IV System Using Spectroscopic Methods

Liaisons: Bob Siefert, Dean Allgeyer

Advisor: Nancy Lape

Students: Ben Coleman (TL), Cynthia Kung,
Abbygail Palmer, Kathleen Wang,
Lauryn Baranowski (F)

Errors during the administration of intravenous medications, such as the delivery of incorrect drugs or dosages, can have potentially fatal effects on the patient. The Cardinal Health Drug Verification Clinic Team has developed a device that will help to eliminate these errors. The device utilizes UV spectroscopy to provide an inexpensive and noninvasive means to verify the identity and concentration of drugs flowing in an IV Tube, allowing errors in drug delivery to be caught before harming the patient.

Center for Integration of Medicine and Innovative Technology (CIMIT)

Blast Armor Using Machine-Augmented Composite Material

Liaison: L. Alex Pranger '92/93

Advisor: Nancy Lape

Students: Nick Sherrow-Groves (TL), Diego
Gonzalez, Chris Lee, Michael Martin
(S), David Su (F), Jinsun Yoo (F)

Blast waves can cause various types of injury, including eardrum rupture and severe pulmonary hemorrhaging. Soldiers in Iraq and Afghanistan are increasingly at risk of this type of injury from IEDs and other explosives, since the ceramic armor currently in use by the United States military is not effective in blast situations. The goal of this project is to develop armor to mitigate blast energy from explosive sources, using Machine-Augmented Composite (MAC) material.

CTG Energetics, Inc.

Campus Sustainability Database

Liaisons: Malcolm Lewis '67, Jon Roberts '93,
Jens Gardner '07, Hossein Shahrokni

Advisor: Reza Miraghaie

Students: Zane Montgomery (TL), Matthew
Jeffryes, Alicyn Henkhaus (S), Ali
Mert Gokgoz (EX-F), Claire
O'Hanlon (F), Rebecca Burns (F)

Growing environmental concern has created demand for tools to analyze the environmental impact and sustainability of the built environment. Current tools address only single buildings and specific types of resources. CTG Energetics has developed the Sustainable Communities Model (SCM) to provide an integrated tool for analyzing a wide variety of impacts in new development and assigned the team the task of adapting this tool for an existing community, specifically a college campus.

DIRECTV Inc.

Field Portable Test Kit

Liaisons: David J. Kuether, Joseph Santoru

Advisor: Qimin Yang

Students: Andrew Cox (TL), Austin Katzin,
Guillaume Reinhard, Nikhil Sonde,
Jason Suiers

The Harvey Mudd Clinic team was asked to design and construct a Field Portable Test Kit for use in analyzing Satellite signal characteristics. The kit must accept a downlink satellite dish signal and perform a variety of tests on this signal. It should meet an airline's restrictions for any checked baggage and be able to be carried by one person.

* "(F)" Fall Semester
"(S)" Spring Semester

* "(EX)" Exchange Student

Firestone Center for Restoration Ecology

Vertical Axis Wind Turbine for Remote Research

Liaison: Carol Brandt
Advisor: Carl Baumgaertner
Students: Christopher Moore (S-TL), Chris Yoo (F-TL), Corina Tom, Susan Kim, Kelley Hodges (F)

The team has designed and built a functional prototype of a 300 watt vertical axis wind turbine to be used in a remote weather monitoring and wild life observation station in Costa Rica. The turbine will be used for battery charging and will supply a minimum of 200 watt-hours per day without making a significant impact on the surrounding environment. The turbine is designed to withstand the high level of moisture and wild life present in the proposed environment.

Honeywell Aerospace

Analysis of Two-Phase Flow in OBIGGS Distribution Systems

Liaisons: Ken Erickson, Andrew Earl
Advisor: Reza Miraghaie
Students: Andrew Kuntjoro (TL), Andrew Felix, Jowene Wong, Michael Van Antwerp (F), Brad Witkowski (F), Charles Gastil (S)

The On-Board Inert Gas Generating System (OBIGGS) is an important part of an aircraft's on board fuel supply safety system. Due to complex geometries presented by fitting the system in the aircraft's wings, it is possible for the distribution system to dip into a fuel tank, allowing fuel to entrain in the pipes. This clinic project tests the effectiveness of the OBIGGS System in clearing entrained fuel by simulating geometries and conditions found in an aircraft.

Lawrence Livermore National Laboratory

Optimizing a Water-Based Muon Detector

Liaison: Steven Dazeley
Advisor: Erik Spjut
Students: Ben Stanphill (TL), Bertrand Achard, Lupita Bermudez, Danny Lim (S), Justin White (F)

The LLNL Clinic team is experimenting with changing various design parameters of a water-based muon detector. When muons pass through water, they give off Cherenkov radiation, which is mostly in the ultraviolet (UV) range. Cherenkov radiation is very dim, so Photomultiplier Tubes (PMTs) are used to detect it. Unfortunately, PMTs do not detect UV radiation well. The team is testing a variety of methods to increase the detection rate of muons.

Los Alamos National Laboratory

Ultra-Low Magnetic Resonance Imaging System

Liaison: Michelle Espy
Advisor: Bob Schaffer
Students: Zack Rubin (TL), Anu Kohli, Kenny Quinn (S), Andy Wong (S), Andrew Lawrence (F), Jon Lake (F)

Design and construct an ultra-low field magnetic resonance imaging (ULF MRI) system. The ULF MRI includes measurement, longitudinal and transverse gradient coils, a supportive structure and an adjustable bed for the test patient. All coils must produce magnetic fields that vary less than 1% from the nominal field within a human head-sized volume.

* “(TL)” Indicates Team Leader
“(PM)” Indicates Project Manager

Northrop Grumman Corporation *Creating a More Environmentally-Friendly Aerospace Industry: Lead-Free Design and Manufacturing*

Liaisons: Randy Bremner, Chandra Sharma,
Evan Sworzyn

Advisor: Ziyad Duron

Students: Gena Urowsky (TL), Monica Ascarrunz, Kevin Festini (S), Shannon McKenna (S), Annika Eberle (F), Sam Gordon (F), Kacy McKibben (F)

Lead-free solder is becoming prominent in a variety of industries and awareness is increasing from the environmental engineering trends. The Northrop Grumman Clinic Team examined and compared the reliability of lead-free solder with traditional leaded solder. Life-time reliability of components was evaluated by using accelerated thermal cycling to simulate several years of the products life cycle; vibration and shock testing were also completed. Examination via imaging of the solder joints allowed for further analysis.

Opto 22 *Wireless I/O Commissioning System*

Liaisons: Matt Chang '95, Tommy Leung '05

Advisor: Qimin Yang

Students: Philip Amberg (S-TL), David Schimon (F-TL), Arjun Kalyanpur, Trevor Ashley (S), Ben Taborsky (F), April Hui (F)

Opto 22 is an industry leader in wired I/O and industrial automation devices. Advances in low-power and low data rate wireless technology have now made wireless I/O systems possible. Opto 22 is developing wireless I/P hardware based on the Zigbee standard. This project is the creation of a commissioning tool that will improve the user's current experience with mesh networking, allowing the customer to easily configure, deploy, and maintain their Opto 22 wireless I/O devices.

Orthodyne Electronics *Develop & Validate a Mathematical Model of a Wire Bonder Structure for Use in the Development of Future Platforms*

Liaison: Eric T. Scranton

Advisor: Samuel DiMaggio

Students: Rosemary Todd (TL), Charles Clapper, Austin Rutledge, Vatche Attarian (S), Max Myers (F)

Orthodyne Electronics has commissioned the Harvey Mudd College Clinic team to develop a mathematical model of a 3600Plus wire bonder under motor-induced loads. During operation, a low frequency resonance limits machine performance, particularly at high accelerations. Noticeable vibrations caused by this resonance have caused concern among some customers. The model should be able to reproduce current machine responses and should be easily configurable so that it can be used to develop future bonder platforms.

Raytheon Space & Airborne Systems

Satellite Payload Test Bed for Radiation Hardness Testing

Liaisons: John Silny '05, Kevin Ota '02

Advisor: Samuel DiMaggio

Students: Gordon Hoople (TL), Zach Lupei (TL), Nisha George, Ryan Quarfoth, Trevin Murakami (F)

Raytheon is developing a new processor, the MONARCH, for use in space-related applications. The team designed and constructed components of a nano-satellite that will monitor cosmic ray disruption of processor performance. The prototype satellite demonstrates the feasibility of using the small, standardized CubeSat form to run the high power processor.

* “(F)” Fall Semester
“(S)” Spring Semester

* “(EX)” Exchange Student

Southern California Edison- Innovation

Acetylene Gas Monitoring in Distribution Transformers

Liaison: Jim Palma

Advisor: Clive Dym

Students: Nina Bordeaux (S-TL), Natasha Reddy (F-TL), Alexander Lynch, Guillaume Bernuit, Ibrahim Shaikh (F)

Distribution transformers may experience failure due to low level internal arcing in the dielectric oil, which generates acetylene gas. Acetylene is explosive and may be hazardous for linemen working on the transformer. SCE wishes to develop a device that can be used safely in the field to collect gas samples from distribution transformers for analysis. The team worked to design and build a prototype, and after testing, develop a final design that can be manufactured and used in the field.

Southwest Research Institute

Balloon-Borne Telescope

Liaisons: Eliot Young, Mark Bullock

Advisor: Patrick Little

Students: Alan Kraut (TL), Kevin Swartzlander, Elton Wong, Graham Orr (S), Yusuke Nakaya (EX-S), Tony Wimer (F)

Balloon-borne telescopes represent a way to achieve the quality of imaging of space based telescopes, at a fraction of the cost. However, current solutions for image stability on balloon-borne telescopes are not sufficient for all scientific imaging tasks. This project is a feasibility study on the design of an image stabilization system with a significant increase in performance over any existing system.

Space Systems/Loral

Low-Shock Solution for Satellite Solar Array Deployment

Liaisons: Mark Zanella, Gerrit Van Ommering

Advisor: Clive Dym

Students: Casey Schilling (TL), Mike Chan, Michael Crockett, Noel Godinez, Daniel Rodriguez (F)

Current Space Systems/Loral satellites are powered by solar arrays that are initially folded and secured against the side of the satellite by pretensioned rods. Upon reaching orbit, knives driven by small explosive charges cut each rod, allowing for solar array deployment. However, the sudden release of the tension in the rods produces undesirable shock. The team has been asked to design a lower-shock alternative to the current retention and release design.

SRI International

Ad-Hoc In-Building Tracking System

Liaisons: Tony Hawkins '01, Gary Okerson '95, John Shockley, Jonathan Solnit

Advisor: Joseph King

Students: Matthew Weiner (TL), Jeff Jones (F-TL), Eric Burkhardt, Nitin Savant, Eric Young (F)

GPS-based tracking has become commonplace, but it is of little value in areas where the GPS signals are not sufficiently reliable to get an accurate position, such as inside buildings. To overcome this shortfall, the team has created a dead reckoning tracking system that can locate an individual indoors without any previous knowledge of the building or preexisting infrastructure. The system uses ultrasonic ranging to find the distance and direction of each of the user's footsteps.

* “(TL)” Indicates Team Leader
“(PM)” Indicates Project Manager

* “(KGI) Keck Graduate Institute
“(EX) Exchange Student

Sun Microsystems

Building Ships for Fleet

Liaison: Ivan Sutherland
Advisor: David Money Harris
Students: Justin Soprano (S-TL), Anthony Weerasinghe (F-TL), Michael Dayringer, Steven Huntzicker (S), Whitney Hsiung (F)

Sun Microsystems laboratory is building an experimental computer chip called FLEET which consists of computational elements called SHIPs connected through an asynchronous on-chip network. The team designed several simple SHIPs for addition to the chip as well as a programmable delay block for timing the SHIPs. The team also investigated the energy-delay tradeoffs of 32-bit static shifters and published the results, with the intent that the best design could be used in FLEET.

TREX Enterprises Corporation

Active Millimeter-Wave Imaging Using Fourier Telescopy

Liaisons: Paul Johnson, Laura Moyer '06, Hope Runyeon '06
Advisor: Bob Schaffer
Students: Dan Goodwin (S-TL), Chris Pong (F-TL), Greg Herschler (S), Hector Cuevas (S), Leah Anderson (F), Hayden Gomes (F), Vicky Wu (F)

This project demonstrates the combination of Fourier Telescopy and millimeter-wave imaging. Millimeter-wave imaging is ideal in security situations, as there is negligible signal disturbance through media such as hair, clothing and wood. This allows dangerous objects to be clearly visible in conventional methods of smuggling through checkpoints. Furthermore, the use of Fourier Telescopy will dramatically reduce the amount of hardware necessary compared to existing millimeter wave images.

KGI/ENGINEERING CLINIC

Gilead Sciences

Automated Visual Inspection Project

Liaisons: Tarq Bunch, Gerard Jensen
Advisors: Ruye Wang (HMC), Jim Sterling (KGI)
Students: Natt Supab (TL), Tirso Alvarez (EX-S), Vicki Chen (F), Oliver Johnson (S), Anna Lei (F), Autumn Petros-Good (S), Michael Ross (F), Sanket Borad (KGI-S), Jayasri Prabakaran (KGI-S), Parvin Rastegar (KGI-S)

Gilead Sciences, an integrated biopharmaceutical company, manually inspects all incoming materials and final product which pass through their San Dimas manufacturing site. The first goal of this project is to design an automated pill inspection systems for Gilead's IQA department using image processing techniques to deliver a software-based rules engine that will detect, classify and quantify defects. The second goal, spearheaded by the KGI side of the team, is to evaluate high throughput fully-automated inspection systems for Gilead's manufacturing side.

- * **“(F)” Fall Semester**
- “(S)” Spring Semester**

MATHEMATICS CLINIC

Beckman Coulter, Inc.

Modeling Bead-Based Immunoassays

Liaisons: Stephen L. Pentoney Jr., David L. Yang, Paul Kraght '81, Veronica Colinayo

Advisor: Henry Krieger

Students: Nadia Abuelezam, Tracy Backes (PM), Catherine Bradshaw (S), David Gross, Brian Stock (F), Marielle Wardell

Beckman Coulter, Inc. produces a wide range of immunoassays as medical diagnostic tests. Using the prostate specific antigen (PSA) immunoassay, a test for diagnosing prostate cancer risk, last year's Clinic team modeled the molecular interactions of bead-based immunoassays. This year's team extended the previous model to encompass the entire immunoassay process, tested the effects of changing experimental parameters by performing the PSA immunoassay under varying conditions, and developed statistical tools to compare model simulations with experimental data.

Citadel Investment Group

Investigating Returns to Pairs Trading Strategies

Liaisons: Russ Osborn '06, Mike Schubmehl '02

Advisor: Andrew Bernoff

Students: Asaf Bernstein (PM), Jason Fennell, Patrick Foley, Zachary Rogstad, Kenn Tevin

The Clinic team investigated pairs trading, a quantitative investment strategy that identifies and exploits highly-correlated stock pairs to produce a high profit-to-risk ratio. The team designed software to automate testing of this strategy allowing them to reproduce results in the academic literature and investigate the driving factors behind a previously documented trading rule. They identified how sensitive the existing method is to a variety of parameters and have suggested strategies for optimizing the returns along with fertile areas for further investigation.

Laserfiche

Automated Dewarping Algorithms for Enhancing Camera-Based Document Acquisition

Liaisons: Karl Chan '89, James Egan '06, Kurt Rapelje

Advisor: Darryl Yong

Consultant: Weiqing Gu

Students: Logan Gordon, Martin Hunt (PM), Maria Pavlovskaja (S), Trang Pham (F), Will Tipton

It is often faster and more convenient to digitize physical documents using photographs from digital cameras rather than scanners. However, such photographs suffer from perspective distortion, bends and folds in the documents and other imperfections. The Clinic team designed and implemented algorithms that can correct these distortions. The team's system automatically dewarps photographs of documents to improve the readability of the images for both humans and computers.

WorldQuant, LLC

Efficient Stock Trading

Liaisons: Jeff Miller '98, Brian Johnson '98

Advisor: Susan Martonosi

Students: Greg Borish, Jason Christiansen (PM) Alex Korn, Minal Shankar

Hedge funds often trade thousands of shares of a stock each day. Market impact and liquidity constraints make it a poor financial decision to execute these large trades in a single order. Rather, it is wise to split the order into several small orders to minimize costs. The purpose of this project is to develop and test an algorithm which will efficiently split large orders to obtain the best average price over all shares traded.

* "(TL)" Indicates Team Leader

"(PM)" Indicates Project Manager

PHYSICS/ENGINEERING CLINIC

HMC-Physical Plant & Campus Planning Committee of the Board of Trustees- Sustainability Clinic *Guiding Sustainability at Harvey Mudd College*

Liaisons: Malcolm Lewis '67, Robert De Pietro
'69, Jon Roberts '93

Advisors: Dan Petersen, Donald Remer

Students: Nathaniel Lyons-Smith (TL), Anthony
Hutain , Maddalena Jackson, Kevin
Byram, Alexandra Simoni (F)

The team was asked to systematically evaluate a broad range of possible conservation-themed projects to improve campus sustainability at HMC. The team developed a set of metrics that prioritizes and compares the performance of diverse projects such as real-time monitoring of electricity usage, solar photovoltaics, and improvements to landscaping. The metrics will also be used to evaluate future HMC sustainability projects.

PHYSICS/MATHEMATICS CLINIC

Southwest Research Institute *Modeling the Performance of a Jupiter Bound Electron Sensor in Strong Magnetic Fields*

Liaisons: Frederic Allegrini, Craig Pollock

Advisors: Ellis Cumberbatch (CGU), Vatche
Sahakian

Students: Kathleen Eliseo (PM-F), Maxim
Gibiansky (PM-S), Joshua Kao, Ethan
Rubin (F), Rocio Ruelas (PM-S),
Mariam Youssef

In August of 2011, NASA will launch the satellite Juno to conduct an in-depth study of the planet Jupiter. On board the satellite there are three electrostatic analyzers (ESAs) that will measure the energy and trajectory direction of electrons in Jupiter's auroras. The behavior and performance of ESAs is well understood in the absence of a magnetic field. It was the task of this Clinic team to account for the effect of these magnetic fields. The team ran computer simulations of the ESAs in magnetic fields of varying magnitude and direction. Mathematical models were then devised for the energy of the electrons and their incoming angle relative to the direction of the magnetic field. These models can be used to translate the data that will be collected by the ESAs into a map of the spectrum of the electrons near Jupiter.

