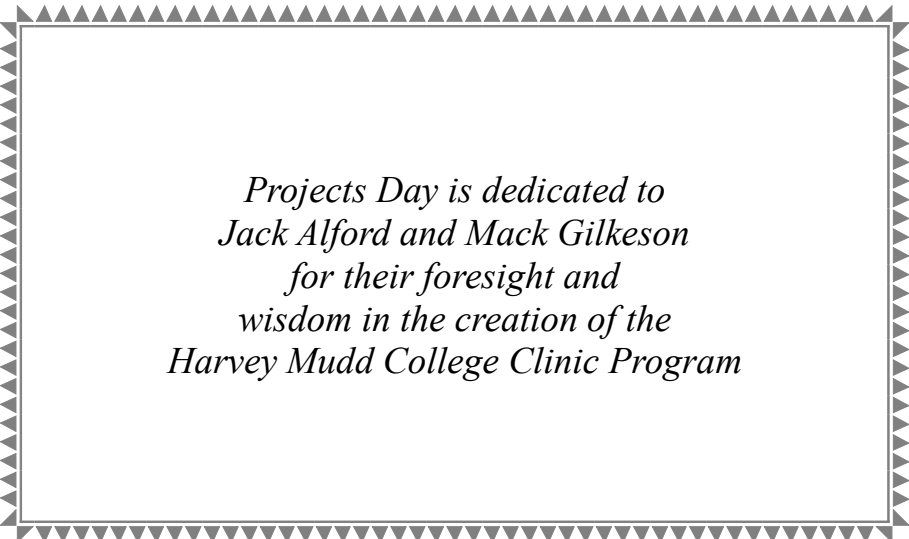


2011 PROJECTS DAY

Tuesday, May 3rd
10:30 a.m. to 6:00 p.m.



*Projects Day is dedicated to
Jack Alford and Mack Gilkeson
for their foresight and
wisdom in the creation of the
Harvey Mudd College Clinic Program*

41st Annual Projects Day

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

Robert Keller, Director
Computer Science Clinic

Erik Spjut, Director
Engineering Clinic

David Money Harris, Associate Director
Engineering Clinic

Susan Martonosi, Director
Mathematics Clinic

Rachel Levy, Associate Director
Mathematics Clinic

Richard Haskell, Director
Physics Clinic

Lisette dePillis, Director
Global Clinic

Patrick Little, Interim Director
Global Clinic

Harvey Mudd College
PROJECTS DAY
May 3, 2011

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 - Susan Martonosi, Director, Mathematics Clinic

Milestone Awards - Robert J. Cave, Dean of Faculty

Recipients:

CareFusion

Los Alamos National Laboratory

Medtronic

Oregon Biomedical Engineering Institute

Southern California Edison

Space Systems/Loral

1:30 - 3:00 p.m. Project Presentations See Schedule

3:00 - 3:30 p.m. Break Hixon Court

3:30 - 5:00 p.m. Project Presentations See Schedule

5:15 - 6:00 p.m. Poster Reception Linde Activities Center
Guests, Faculty, and Students

Schedule of Presentations

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	
CLAREMONT GRADUATE UNIVERSITY (CGU)/MATHEMATICS CLINIC Los Alamos National Laboratory (LANL) <i>Optimizing Smart Power Grids</i>	X		X		X		J-B134
CLAREMONT GRADUATE UNIVERSITY (CGU)/ENGINEERING/MATHEMATICS CLINIC DYNAR Collaboration, Claremont Graduate University <i>Cooperative Autonomous Aquatic Vehicles: Mathematics and Robotics</i>	X		X		X		Pryne
COMPUTER SCIENCE CLINIC CalTech Keck Institute of Space Sciences <i>A Virtual Telescope for Global Monitoring of Earth Surface Changes</i>	X		X		X		B-B126
Facebook <i>Indexing Improvements for the Hive Database System</i>	X		X		X		Edwards
National Ecological Observatory Network, Inc. (NEON) <i>Common Data Services to Support Continental-Scale Ecology</i>	X		X		X		B-B105
Paramount Pictures <i>Quantifying the Elements of Film Piracy</i>		X		X		X	Edwards
QUALCOMM <i>3D Social Augmented Reality</i>		X		X		X	B-B105
Sandia National Laboratories <i>Exploring the Feasibility of 2D Matrix Partitioning</i>	X		X		X		B-B134
Yelp!, Inc. <i>Yelp Crawler</i>		X		X		X	B-B126
COMPUTER SCIENCE/MATHEMATICS CLINIC Community of Ordinary Differential Equations Educators (CODEE) <i>ODE Toolkit</i>		X		X		X	B-B134

Building Codes:

B = Beckman

J = Jacobs

P = Parsons

LSC = Learning Studio Classroom-Sprague Learning Center

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

Edwards = Galileo-Edwards

McAlister = Galileo-McAlister

Pryne = Galileo-Pryne

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	
ENGINEERING CLINIC							
The Aerospace Corporation <i>Digital Receivers for Wideband Chaotic Signal</i>	X		X		X		P1283
Arizona Public Service (APS) <i>Dry Ash Transport for the Cholla Power Plant</i>	X		X		X		LSC
Barling Bay, LLC <i>Remotely Controlled Dimming Solution for High Efficiency Light Bulbs</i>	X		X		X		P-B146
Boeing, SoCal <i>Transverse Biased Induction Motor</i>		X		X		X	P-B181
CareFusion <i>Fluid-Driven Coaxial Peristaltic IV Pump</i>	X		X		X		P-B183
DirecTV, Inc. <i>Adaptation of DirecTV's Advanced Installation Meter for Home Networking Diagnostics</i>	X		X		X		P2383
Insight Surgical Instruments LLC <i>Design and Development of a Minimally Invasive Bone Wax Applicator</i>		X		X		X	P1285
Los Alamos National Laboratory (LANL) <i>HAWC Gamma Ray Observatory</i>	X		X		X		McAlister
Los Alamos National Laboratory (LANL)/Cal-State University of Los Angeles (CSULA) <i>Cooling Water Purification and Monitoring System for LANSCE Particle Accelerator</i>	X		X		X		P1287C
Los Alamos National Laboratory (LANL) <i>Wind Turbine Dynamic Modeling with Experimental Validation</i>	X		X		X		P1277
Los Alamos National Laboratory (LANL) <i>Construction of X-Ray Diagnostic Subsystems</i>		X		X		X	McAlister
Los Angeles Department of Water and Power (LADWP) <i>Owens Lake Dust Mitigation</i>		X		X		X	P2383
M2 Renewables, Inc. <i>Mechanical De-watering Device</i>		X		X		X	P1287C
Medtronic Diabetes <i>Optical Glucose Sensor: Lifetime-Based Reader Device</i>		X		X		X	P1277
N2Pops <i>Design of a Rapid Ice Pop Freezing Machine</i>		X		X		X	P1275
Northrop Grumman Corporation <i>Embedded Passive Components in Printed Circuit Boards</i>	X		X		X		P-B181
Optivus Proton Therapy <i>X-Ray Alignment Fixture</i>	X		X		X		P1285
Oregon Biomedical Engineering Institute (OBEI)/ RevMedX, Inc. <i>Characterization of Mechanism of Expansion of Advanced Hemostatic Agent</i>		X		X		X	P1264
Sandia National Laboratories <i>High Temperature, High Speed Data Link for Geothermal Tools</i>		X		X		X	P-B183

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	
Southern California Edison (SCE) <i>Recomissioning of the Hoch-Shanahan Dining Commons</i>		X		X		X	P2358
White-Rodgers Division of Emerson <i>Spectral Flame Sensing</i>		X		X		X	LSC
ENGINEERING/PHYSICS CLINIC							
Lawrence Livermore National Laboratory (LLNL) <i>Axion Dark Matter Experiment (ADMX)</i>		X		X		X	Pryne
Lawrence Livermore National Laboratory (LLNL) <i>Photocathode Optimization for a Dynamic Transmission Electron Microscope</i>	X		X		X		P1264
Lawrence Livermore National Laboratory (LLNL) <i>Cryogenic Insulation Design for Liquid Hydrogen Automobiles</i>	X		X		X		P1275
National Renewable Energy Laboratory (NREL) <i>Getting Dirty: A Testing Approach to Soiling in Concentrating Solar Power Plants</i>		X		X		X	P-B146
GLOBAL CLINIC							
India/ Birla Institute of Technology <i>Economical Solar Thermal Storage System for Rural Communities of India</i>	X		X		X		J-B132
Bio-Rad Laboratories/National University of Singapore (NUS) <i>Novel Technologies for Protein Separations</i>		X		X		X	J-B132
Operation Hope Foundation/National University of Singapore (NUS) <i>Micro Vegetable Processor and Packager for Poor Rural Vegetable and Fruit Farmers in Developing Countries</i>	X		X		X		P2358
MATHEMATICS CLINIC							
Space Systems/Loral (SS/L) <i>Application of Robust Control to Spacecraft Attitude Stability</i>		X		X		X	J-B134

2010/2011 Clinic Sponsors

**Claremont Graduate University
(CGU)/Mathematics**
Los Alamos National Laboratory (LANL)

**Claremont Graduate University
(CGU)/Engineering/Mathematics**
DYNAR Collaboration, Claremont
Graduate University

Computer Science
CalTech Keck Institute of Space Sciences
Facebook
National Ecological Observatory Network,
Inc. (NEON)
Paramount Pictures
QUALCOMM
Sandia National Laboratories
Yelp!, Inc.

Computer Science/Mathematics
Community of Ordinary Differential
Equations Educators (CODEE)

Engineering
The Aerospace Corporation
Arizona Public Service (APS)
Barling Bay, LLC
Boeing, SoCal
CareFusion
DirecTV, Inc.
Insight Surgical Instruments, LLC
Los Alamos National Laboratory (LANL)
Los Angeles - Department of Water and
Power
M2 Renewables, Inc.
Medtronic Diabetes
N2Pops
Northrop Grumman Corporation
Optivus Proton Therapy

Oregon Biomedical Engineering Institute
(OBEI)/RevMedX, Inc.
Sandia National Laboratories
Southern California Edison (SCE)
White Rodgers Division of Emerson

Engineering/Physics
Lawrence Livermore National Laboratory
(LLNL)
National Renewable Energy Laboratory
(NREL)

Global
India/Birla Institute of Technology (BIT)
National University of Singapore (NUS)/
BioRad
National University of Singapore (NUS)/
Operation Hope

Mathematics
Space Systems/Loral (SS/L)

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Rachel Levy, *Associate Director, Mathematics Clinic*
Richard Haskell, *Director, Physics Clinic*
Lisette dePillis, *Director, Global Clinic*
Patrick Little, *Interim Director, Global Clinic*

Personalized Projects Day Schedule

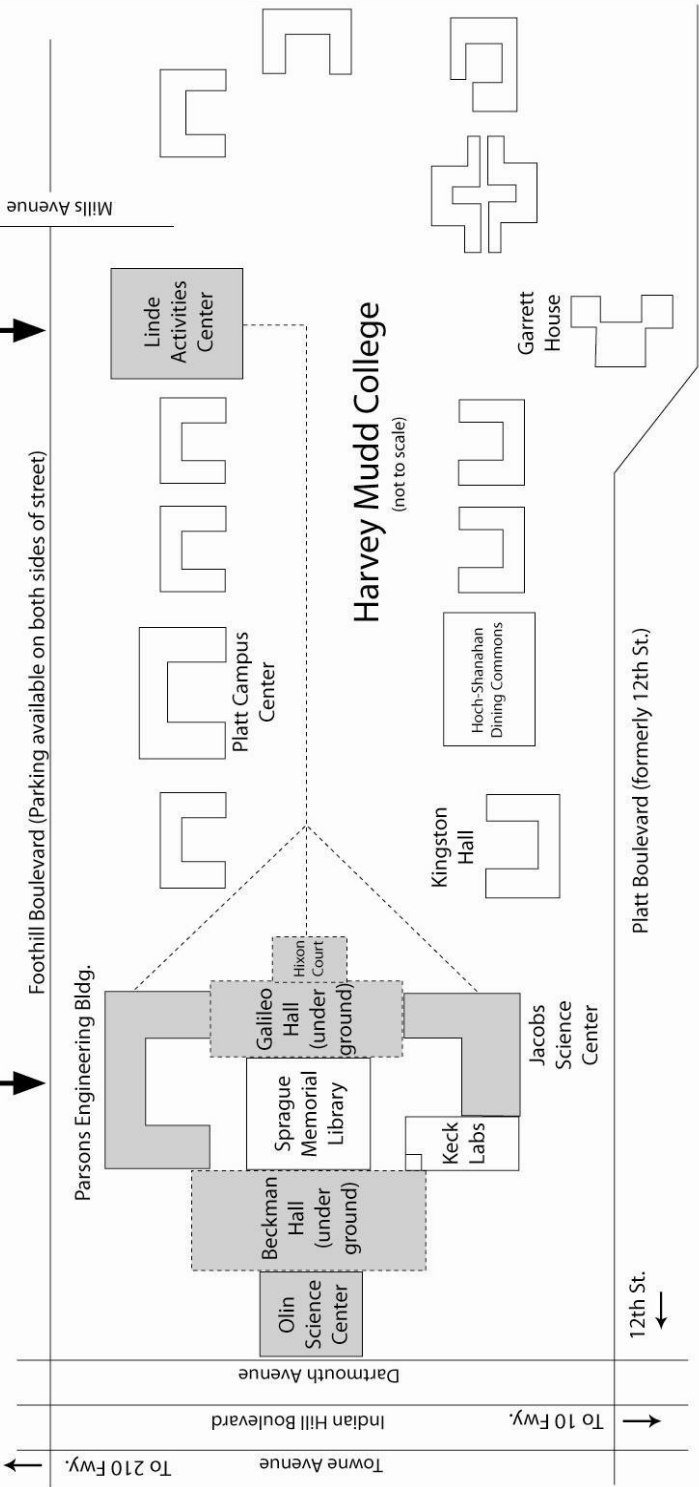
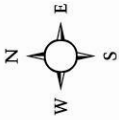
Please fill in the empty slots below with the presentations you would like to attend.

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.		
5:15 p.m. - 6:00 p.m.	Poster Reception	Linde Activities Center

Projects Day Campus Map

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

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



Harvey Mudd College
(not to scale)

Refreshments

1 || 6

11 || 16

←
East

Refreshments

21 || 26

31 || 36

2 || 7

12 || 17

22 || 27

32 || 37

Poster Session
Layout
Projects Day

3 || 8

13 || 18

23 || 28

33 || 38

4 || 9

14 || 19

24 || 29

34 || 39

5 || 10

15 || 20

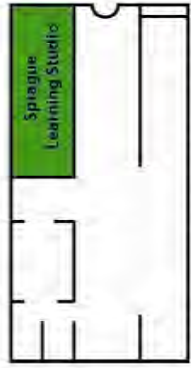
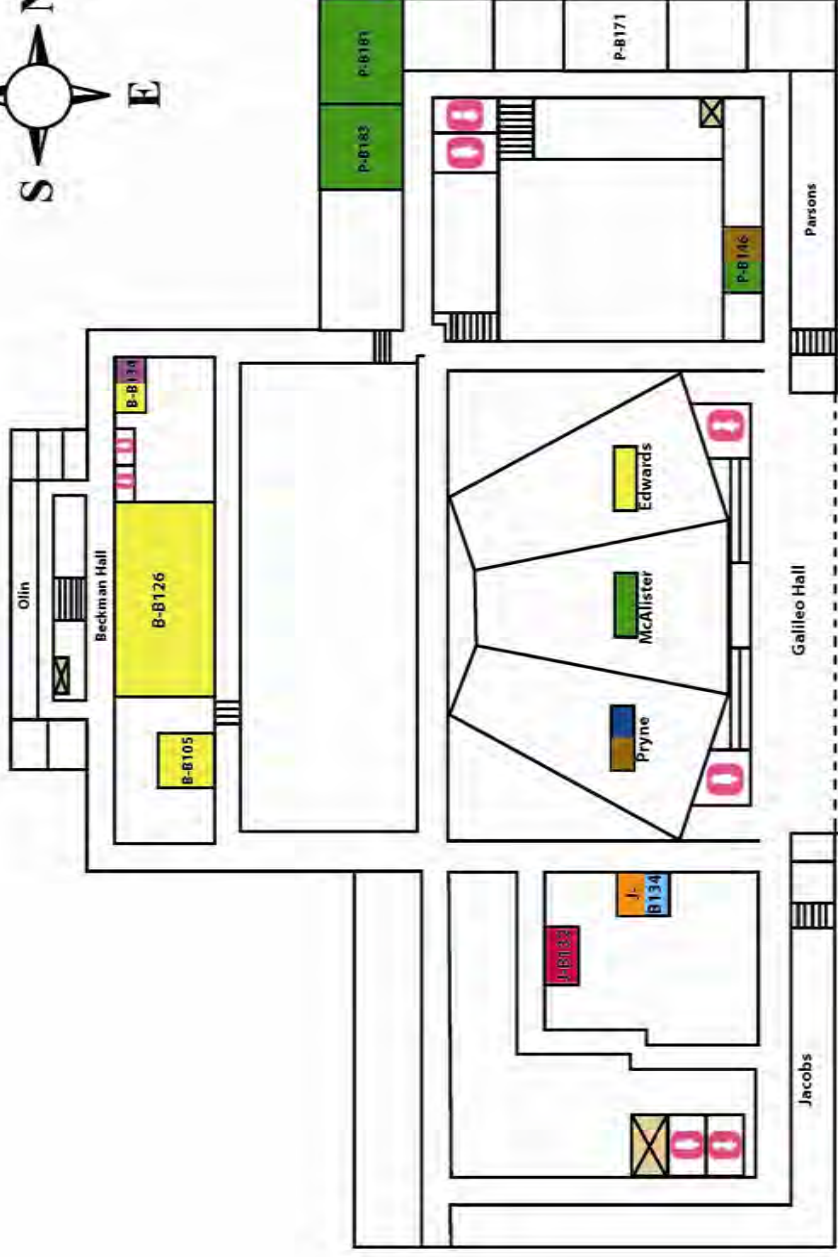
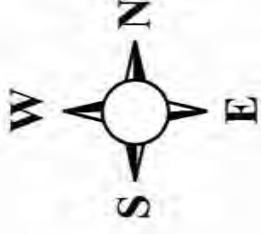
25 || 30

35

Linde
Activities
Center

Key to Poster Session Layout

1. The Aerospace Corporation
2. Arizona Public Service
3. Barling Bay, LLC
4. Boeing, SoCal
5. CalTech Keck Institute of Space Sciences
6. CareFusion
7. Community of Ordinary Differential Equations Educators (CODEE)
8. DirecTV, Inc.
9. DYNAR Collaboration, Claremont Graduate University
10. Facebook
11. India/Birla Institute of Technology (BIT)
12. Insight Surgical Instruments, LLC
13. Lawrence Livermore National Laboratory-ADMX
14. Lawrence Livermore National Laboratory-DTEM
15. Lawrence Livermore National Laboratory-LH2
16. Los Alamos National Laboratory-Gamma Ray
17. Los Alamos National Laboratory-Math/CGU
18. Los Alamos National Laboratory-Purification
19. Los Alamos National Laboratory-Wind Turbine
20. Los Alamos National Laboratory-X-Ray
21. Los Angeles Department of Water and Power (LADWP)
22. M2 Renewables
23. Medtronic Diabetes
24. N2Pops
25. National University of Singapore (NUS)/BioRad
26. National University of Singapore (NUS)/Operation Hope
27. National Ecological Observatory Network, Inc. (NEON)
28. National Renewable Energy Laboratory (NREL)
29. Northrop Grumman Corporation
30. Optivus Proton Therapy
31. Oregon Biomedical Engineering Institute (OBEI)/RevMedX, Inc.
32. Paramount Pictures
33. QUALCOMM
34. Sandia National Laboratories-ENG
35. Sandia National Laboratories-CS
36. Southern California Edison (SCE)
37. Space Systems/Loral (SS/L)
38. White Rodgers Division of Emerson
39. Yelp!, Inc.



1st Floor of Sprague Center

Basement Floor of Beckman, Galileo & Parsons



First and Second Floors of Parsons



Legend

- Computer Science Clinic
- Engineering Clinic
- Global Clinic
- Mathematics Clinic
- CS/MATH Clinic
- Engineering/Physics Clinic
- CGU/Mathematics Clinic
- Engineering/Mathematics Clinic
- Restrooms
- Stairs
- Elevator

CGU/MATHEMATICS CLINIC

Los Alamos National Laboratory (LANL)

Optimizing Smart Power Grids

Liaisons: Russell Bent, Ph.D.,

Jason Johnson, Ph.D.

Advisor: Allon Percus (CGU)

Students: Robert Carrington (PM-F),
Amelia Musselman (PM-S),
Mark Wilson (CGU)

The development of a power system based on renewable resources requires an appropriately designed power grid. This has become increasingly important as the transfer from non-renewable to renewable energy sources has become widespread. Our project focuses on optimizing the power grid design by minimizing the combined costs of transmission line placement and power loss. We are developing a hybrid approach for the optimization problem, combining the discrete method of genetic algorithms with a continuous Newton's method.

CGU/ENGINEERING/ MATHEMATICS CLINIC

DYNAR Collaboration, CGU

Cooperative Autonomous Aquatic Vehicles: Mathematics and Robotics

Liaisons: Rachel Levy (HMC),

Allon Percus (CGU)

Advisor: Susan Martonosi

Students: Jennifer Flenner (CGU-F),
Matthew Keeter, Dan Moore,
Ryan Muller (PM), Eric Nieters

The Dynamic Networks for Aquatic Robots (DYNAR) research group is developing algorithms for autonomous submarines to cooperatively search an aquatic region. The clinic team has implemented multiple randomized search algorithms for three-dimensional bounded environments and tested them in simulation. In an aquatic testbed, the team has improved computer-to-submarine communication and created software for tracking the motion of submarines. The search algorithms have been implemented in the testbed to compare data from the physical environment with theoretical results from the simulations.

COMPUTER SCIENCE CLINIC

CalTech Keck Institute of Space Sciences

A Virtual Telescope for Global Monitoring of Earth Surface Changes

Liaisons: Dr. Sebastien Leprince, Francois Ayoub

Advisor: Michael Erlinger

Students: Sonja Bohr (PM), Emma Carlson,
Singer Ma, Julia Matsieva

COSI-Corr (Co-registration of Optically Sensed Images and Correlation) is a software developed at CalTech that estimates ground displacements using multi-temporal satellite images. Among other uses, correlating such images enables geologists to locate earthquake fault ruptures soon after an event. Unfortunately, analysis of a few pairs of images may take on the order of several hours. To improve this response time, our project is to propose a framework that allows the migration of COSI-Corr to a multitude of distributed computing environments.

Facebook

Indexing Improvements for the Hive Database System

Liaisons: Jonathan Hsu '01, John Sichi,
Yongqiang He

Advisor: Robert Keller

Students: Skye Berghel, Jeffrey Lym,
Russell Melick (PM-S),
Marquis Wang (PM-F)

Apache Hive is an open source distributed database/data warehouse system built on the Map/Reduce framework of Hadoop. Designed to handle massive datasets, it is currently heavily used by Facebook. Facebook desires improvements to the indexing framework within Hive, both in handling different types of data and in ease of index use. The team has developed a new index type based on bitmaps, which offers improvements for self-similar datasets. They have also augmented the existing framework to enable automatic creation and use indexes.

National Ecological Observatory Network, Inc. (NEON)

Common Data Services to Support Conti- nental-Scale Ecology

Liaison: DJ Spiess, Bob Tawa

Advisor: Zachary Dodds

Students: Jason Garrett-Glaser, Keith Ingram
(PM), Alejandro Lopez-Lago,
HamsterBob Stewart

The HMC NEON clinic team has designed, proto-
typed, and delivered a Common Data Services
(CDS) subsystem for NEON. Through a single
language and a single file format, CDS offers
programmatic access both to NEON's central data-
base and its many peripheral datasources. CDS is a
software layer with which NEON engineers can
create a wide variety of end-user applications for
visualizing and analyzing ecological data. CDS's
design provides NEON the flexibility to incorpo-
rate new data sources and functionality in the
future.

Paramount Pictures

Quantifying the Elements of Film Piracy

Liaisons: Christopher Lewert, Mark Hall,
Abe Wong '92

Advisor: Christine Alvarado

Students: Jessica Blevins (PM-S),
Dan Ciliske, Rebecca Green (PM-F),
Moira Tagle

Online movie piracy is a major concern for Para-
mount Pictures. Since there are thousands of sites
with illegal content, Paramount's anti-piracy team
requested a means of determining which websites
are the most dangerous and which advertisers
support those sites. Our first project deliverable is
an algorithm for scoring the threat represented by
a given website. The second deliverable is a web
browser extension that retrieves information about
the advertisements which appear on a given piracy
site.

QUALCOMM

3D Social Augmented Reality

Liaison: Parixit Aghera

Advisor: Elizabeth Sweedyk

Students: Karen Gragg (PM), Emily Fujimoto,
Dan Fielder, Eric Mullen

Using QUALCOMM's Augmented Reality Soft-
ware Development Kit, we have created two social
augmented reality applications that support on-
device content creation for the Android phone.
Our initial application, Life Markup, allows users
to place virtual content in the real world. Our sec-
ond application, Virtual Room Designer, focuses
the idea of Life Markup to allow users to arrange
virtual furniture in a real room. In order to devel-
op intuitive interfaces for the applications, we
conducted a series of user studies.

Sandia National Laboratories

Exploring the Feasibility of 2D Matrix Partitioning

Liaisons: Michael Wolf '98, Erik Boman,
Karen Devine, Bill Spotz

Advisor: Christopher Stone

Students: Audrey Lawrence (PM-S),
Michael Leece (PM-F), Joe DeBlasio,
Katie Ewing

Sandia National Labs has developed the Trilinos
software framework for large-scale scientific and
engineering problems. Large, sparse, matrix-
vector multiplications arise frequently in their
problems, and distributing the matrix and vector
among many processors can produce significant
speedup. We extended the Trilinos support for
distributing large matrices, including additional
partitioning algorithms and code to visualize and
evaluate these partitions, and performed an empiri-
cal study of the results.

Yelp!, Inc.

Yelp Crawler

Liaisons: Jason Fennell '08,
Benjamin Goldenberg '10,
Paul Wais '07, Mike Stoppelman
Advisor: Melissa O'Neill
Students: David Huie, Sabreen Lakhani,
Anatole Paine, Yael Mayer (PM)

Yelp is a review-based online business directory. To construct the most accurate and extensive local guide on the Internet, Yelp would like to use the multitude of business websites available on the Internet. To this purpose, the Yelp Clinic team built a web crawler that leverages machine learning algorithms to identify, examine, and index the content of business websites. The resulting system will be integrated as a feature of Yelp's search engine.

COMPUTER SCIENCE/ MATHEMATICS CLINIC

Community of Ordinary Differential Equations Educators (CODEE)

ODEToolkit

Liaisons: Darryl Yong '96, Robert Borrelli
Advisors: Talithia Williams, Christopher Stone
Students: Beky Kotcon, Samantha Mesuro (PM),
Daniel Rozenfeld, Anak Yodpinyanee

The Consortium of Ordinary Differential Equations Educators (CODEE), an organization dedicated to improving the teaching and learning of ordinary differential equations, created an educational, differential equation solving software called ODEToolkit to pursue its goals. During this year, we have implemented an additional numerical solver capable of handling stiff differential equations, made necessary changes to the software's architecture, fixed bugs in the software, and conducted user testing regarding bugs and the usability of the software.

ENGINEERING CLINIC

The Aerospace Corporation

Digital Receivers for Wideband Chaotic Signal

Liaisons: Dr. Samuel S. Osofsky '85,
Dr. Christopher P. Silva
Advisor: Qimin Yang
Students: Sarah Yi (TL-S), Dillon Ayers (TL-F),
Leo Altmann, Eric Zhang,
Mark Ellis (S), William Koven (F)

The Aerospace Corporation has tasked the Harvey Mudd College clinic team with designing, building, and demonstrating the performance of a digital receiver to demodulate wideband chaotic signals produced by the Young-Silva Chaotic Oscillator. The team will characterize receiver performance with figures of merit including bit-error rate and signal-to-noise ratio, explore the sensitivity of performance to variation of system parameters, and produce a professional paper based on the results.

Arizona Public Service (APS)

Dry Ash Transport for the Cholla Power Plant

Liaison: Dennis A. Del Grosso, P.E.
Advisor: Donald Remer
Students: Caitlin Jacques (TL-S),
Javier Morquecho (TL-F),
Margaret Brier (S), Jinhwa Chun (S),
Roxie Bartholomew (F),
William Grabill (F)

In May 2010, the Environmental Protection Agency (EPA) proposed new regulations on coal combustion residuals (CCR). These regulations, if ratified, will require coal ash be disposed of with <50% moisture, which would entail major retrofits to existing plants infrastructure for the transport and storage of CCR. Since coal provides about half of the US's power, this will increase the cost of electricity nationwide, warranting the development of cost-effective solutions. This project analyzed cost-effective dry ash capture and transport systems that would comply with the potential regulatory requirements in the disposal of ash for the Cholla Power Plant.

Barling Bay, LLC

Remotely Controlled Dimming Solution for High Efficiency Light Bulbs

Liaison: Dr. Michael Joost
Advisor: Matthew Watkins
Students: Hannah Troisi (TL-F),
Esther Hwang (TL-S), Kevin Chan,
Max Wishman, Harry Lenahan (F),
Alena Rau (S)

Barling Bay has developed a high-efficiency lighting solution which consists of a replaceable bulb and a semi-permanent base. The company requested that the HMC clinic team extend the capabilities of this bulb. The new prototype developed by the team can be controlled remotely over powerlines and provides ten levels of dimming. The future use of this technology will be in industrial and other large scale settings where a single control center will control the activity of the bulbs in the building.

Boeing, SoCal

Transverse Biased Induction Motor

Liaisons: Robert Atmur, Deborah Beron-Rawdon
Advisor: David Money Harris
Students: Austin Anderson (TL-S),
Nick Card (TL-F), Brendan Smith,
Joseph Min (S), Ryan Williams (F)

The Boeing Corporation recently designed a new motor concept that alters the magnetic fields inside a normal induction motor. Theoretically, the “transverse induction motor” should improve the motor’s overall efficiency. Even a small increase in efficiency would save billions of dollars on energy annually. The Harvey Mudd College Clinic Team designed, built, and tested the relative efficiency of a proof-of-concept, one horse-power transverse induction motor.

CareFusion

Fluid-Driven Coaxial Peristaltic IV Pump

Liaisons: Robert D. Butterfield, Daniel M. Abal,
Dr. Robert Siefert
Advisor: Lori Bassman
Students: Jason Kang (TL-S),
Susanna Lin (TL-F), Marie Godla,
Kirby Haraguchi (S),
Katherine Lownsbery (S),
Mira De Avila-Shin (F), Alex Ross (F)

The team is collaborating with CareFusion in designing a novel peristaltic infusion (IV) pump. The new pneumatic design and coaxial design is hoped to increase accuracy and efficiency, decrease the cost of precision fabrication, and decrease time variation in medication flow rate. The Clinic team has been charged with analyzing the design, optimizing it, and creating a proof-of-concept prototype of the disposable portion of the pump.

DIRECTV, Inc.

Adaption of DirecTV's Advanced Installation Meter for Home Networking Diagnostics

Liaisons: John Norin '90/91, David Patillo,
Owen Finch
Advisor: Matthew Watkins
Students: Kramer Staube (TL-S),
Chris Ferguson (TL-F),
Christian Jolivet (TL-F),
Narayan Propato, Ozzie Gooen

The DirecTV clinic team is designing an embedded application to debug DirecTV's Whole Home network. The project includes: analyzing network data, designing a user interface, and interfacing with DirecTV's Advanced Installation Meter. The team will deliver an application that is ready to be incorporated with existing applications, a programmed AIM which runs the application on startup, and full documentation of the code and the programming process.

Insight Surgical Instruments, LLC
Design and Development of a Minimally Invasive Bone Wax Applicator

Liaisons: Ajay Shah '06, Jeff Manassero '07

Advisor: Elizabeth Orwin

Students: Cassie Nguyen (TL-S),
Matthew Phillips (TL-F),
Tim Challener, Kristen Schunter (F),
Annie Jensen (S), Vincent Pai (S)

Surgeons performing minimally invasive spinal surgeries often have to cut away bone to reveal the operation site. The bone, being living tissue, bleeds into the work site and often hampers the surgeon's vision. Bone wax is used to block the bleeding. Current wax application methods are rather crude, so the team has designed and created a minimally invasive bone wax applicator to facilitate this process.

Los Alamos National Laboratory
HAWC Gamma Ray Observatory

Liaison: Brenda Dingus

Advisor: Ziyad Durón

Students: Kyle Klipfel (TL-S),
Clare Robinson (TL-F),
Matthew Cummins (S),
Benjamin Liu (S), Renee Gittins (F),
Scott Oglivie (F)

This team worked to develop an improved construction method and construction devices for the High Altitude Water Cherenkov Observatory in Mexico. The project centered on optimizing construction safety, time, and cost. The main focus was on the construction of 300 50,000 gallon water tanks, installation and placement of three photo-multiplier tubes in each tank, as well as the light-tight bladder installation within the tanks.

**Los Alamos National Laboratory/
CSULA**

Cooling Water Purification and Monitoring system for LANSCE Particle Accelerator

Liaisons: John Erickson, Sergio Rodriguez,
Brian Smith

Advisors: Patrick Little, Trinh Pham (CSULA)

Students: Michael Anderson (CSULA, TL-S),
Marco Fernandez,
Shaw Gentry (CSULA),
Julia Karl (TL-F), Tae Lee,
Allen Tong (CSULA)

In this joint project with California State University at Los Angeles (CSULA), the student team built a water filtration and monitoring system for the cooling water of the Los Alamos Neutron Science Center (LANSCE) particle accelerator. The goal of the project was to achieve proper levels of conductivity, pH, and oxygen in the water to reduce corrosion in the system and to provide a sensor/software package that allows the filtration system to be remotely monitored as well as controlled via LANL's central network.

Los Alamos National Laboratory
Wind Turbine Dynamic Modeling with Experimental Validation

Liaison: Curtt Ammerman

Advisor: Philip Cha

Students: Visar Jahiu, Jennifer Rinker (TL-F),
Allison Russell (TL-S), Harry Wornick,
Nikki Peck (S), Lowell Reade (F)

In an effort to understand why wind turbines fail prematurely, researchers at LANL have been investigating methods of creating wind turbine models that better predict their actual behavior. The HMC team was asked to create a dynamic, multi-body model of a 3 kW residential scale wind turbine and to validate and refine the model through experimental testing.

Los Alamos National Laboratory
Construction of X-ray Diagnostic Subsystems

Liaisons: Dr. Aaron Koskelo, Dr. Nick Lanier
Advisor: Erik Spjut
Students: Steven Berry (TL-S),
Doo Hyun Chung (TL-F), Paige Pruitt,
Yoichi Sagawa (TL-F),
Alexa Noxon (F)

This project entails the design, construction, interfacing, and testing of a computer-controlled target manipulator, a Ross-filtered diode array, and a soft X-ray grating monochromator for a laboratory-scale X-ray calibration system. The monochromator uses a variable line-spacing grating and the diode array uses different filters to isolate wavelengths within the soft X-ray region. The completed system will be used to calibrate future diagnostics for the National Ignition Facility which will explore the interaction of radiation at these wavelengths with various materials.

Los Angeles Department of Water and Power (LADWP)
Owens Lake Dust Mitigation

Liaison: Yamen Nanne, PMP
Advisor: Anthony Bright
Students: J.J. Boyles (TL-S), Elliot Smith (TL-F),
Danyang Zhao, David Turner,
Matthew Brown (S), Edward Wang (F)

Studies have shown that tilted solar arrays can effectively minimize surface level winds near the array. The LADWP Clinic team has constructed a prototype solar array module to install on Owens (Dry) Lake. The module has been designed to handle the high winds and poor soil conditions present on the Lake. Results from the prototype installation will be used toward a future large-scale project with the goal of dust mitigation.

M2 Renewables, Inc.
Mechanical De-watering Device

Liaisons: Patrick Carnie, Scott Noll,
Ken Stedman, Gerhard Forstner
Advisors: Erik Spjut, Okitsugu Furuya
Students: Erin Powers (TL-F),
Lauren Nishioku (TL-S),
Allison Wynn (TL-S) Isabel Bush (F),
Chelsea Fishbach (F),
Samuel Meyer (S), Alyssa Paulson (S)

M2 Renewables has developed a unique wastewater treatment process where most of the solids are removed in the early steps. The amount of energy, land footprint, and cost are greatly reduced compared to traditional systems. These solids can be gasified and used as a renewable energy resource. We have been tasked to design and prototype a device to de-water the fresh solids to 50% water content, a targeted improvement of 46% in water removal compared to M2R's existing de-watering configuration.

Medtronic Diabetes
Optical Glucose Sensor: Lifetime-Based Reader Device

Liaisons: Soren Aasmul, Katharine Bente
Advisor: Qimin Yang
Students: Daniel Ihlenfeldt (TL), Ariel Berman,
Alex McAuley, Kevin Aiach,
Susan Tan (S), Meera Punjiya (F)

Medtronic Diabetes has tasked the Harvey Mudd team with redesigning a novel continuous glucose monitoring device. Continuous glucose monitoring systems allow diabetics significantly more control over their glucose levels. Increased control raises their quality of life and has the potential to increase life spans. The objectives of the project are to reduce the power consumption, the start-up time, and the size of the device.

N2Pops

Design of a Rapid Ice Pop Freezing Machine

Liaison: Darryl Yong '96
Advisor: Nancy Lape
Students: Winni Wei (TL-S),
Rachid Grimes (TL-F),
Jean-Vincent Hong, Bryan Chow (F),
Sam Ettinger (F), Julie Kraus (S),
Joyce Lin (S)

The N2Pops Clinic Team at Harvey Mudd College has designed, built, and tested a device for automatically freezing ice pops in under 90 seconds. The device successfully freezes custom ice pops in a liquid nitrogen bath using an automated elevator system controlled by an Altera Cyclone III FPGA with a user-friendly interface. The final deliverable is a schematic of the device for manufacture.

Northrop Grumman Corporation

Embedded Passive Components in Printed Circuit Boards

Liaisons: Todd Uramoto, Richard Card
Advisor: Joseph King
Students: Ian Jimenez (TL), Scott Almond,
Rebecca Glick, Madeleine Ong,
Kristen Warren (S)

The Harvey Mudd College Northrop Grumman Clinic Team will design and test printed circuit boards (PCBs) with embedded resistors and capacitors to evaluate the technology for avionics applications. While thermal cycling the PCBs in a Thermotron environmental test chamber, a data acquisition system will be used to determine the impedance variation over temperature and time. The results from these tests will be analyzed to form a model of the life expectancy of embedded components in PCBs.

Optivus Proton Therapy

X-ray Alignment Fixture

Liaison: Nickolas Rigney
Advisor: Philip Cha
Students: Tom Strizic (TL-S),
Kristina Runas (TL-F),
Winnie Ding (F), David Golay (S),
Josh Rowe (S), Brian Soe (F)

The 2010-2011 Optivus Proton Therapy Clinic Team will design, assemble, and test a tool for precise x-ray alignment and alignment validation to be used in an active proton beam delivery system at LLUMC. The device must be lightweight, easy to use, and able to withstand daily repeated use for over 20 years.

Oregon Biomedical Engineering Institute (OBEI)/RevMedX, Inc.

Characterization of Mechanism of Expansion of Advanced Hemostatic Agent

Liaisons: Dr. Kenton Gregory, Andrew Barofsky,
Mary Bullard, Teresa Pineda '06
Advisor: Elizabeth Orwin
Students: Christopher Ramos (TL-S),
Katherine Maddalena (TL-F),
Stephen Kwong (S), Elissa Leonard (S),
Andrew Ho (F), Sara Sholes (F)

The OBEI Clinic team determined the mechanism of liquid-induced expansion of advanced hemostatic agent (AHA) sponges. The team hypothesized that molecular interaction between water and regenerated cellulose strongly affects expansion. Other contributing factors include temperature, sponge composition, fluid properties, and initial moisture content. The team designed experimental procedures to characterize pore structure, wettability, absorption, material properties, and expansion. Additionally, finite element modeling of the AHA sponges provided insight to internal fluid dynamics and a basis for comparison to experimental results.

Sandia National Laboratories
High Temperature, High Speed Data
Link for Geothermal Tools

Liaisons: Scott Lindblom, Joseph Henfling
Advisor: David Money Harris
Students: Andrew Macrae (TL-S),
Kevin Yeung (TL-F), Kyle Baran,
Gregory Fong (S), Johnson Qu (S),
Tynan McAuley (F), James Parks (F)

Sandia National Laboratories has developed a drilling diagnostic system with the goal of reducing the costs of geothermal well drilling. The system, known as Diagnostics While Drilling (DWD), transmits a variety of critical data from the drill bit location back to an operator at the surface over 5,000 feet of single conductor wireline. The team built a receiver to recover degraded signals from the DWD electronics at a rate of 800 kbps, which represents a four-fold increase over Sandia's initial system.

Southern California Edison
Recommissioning of the Hoch-Shanahan
Dining Commons

Liaison: Brian James
Advisor: Adrian Hightower
Students: Kirsten McAfee (TL-S),
Benjamin Ryan (TL-F),
Benjamin Hsieh, Matthew Davis (S),
David King (F)

The Southern California Edison Clinic project consists of executing and evaluating the process of recommissioning an existing building. This consists of analyzing the energy consumption and energy-related building operations of the LEED certified Hoch-Shanahan Dining Hall at Harvey Mudd College using historical and present-day building data. Through this analysis, the team can identify inefficiencies and make recommendations to improve building performance in hopes to meet or exceed the as-built energy performance specifications.

White-Rodgers Division of Emerson
Spectral Flame Sensing

Liaison: Jeff Arensmeier
Advisor: Nancy Lape
Students: Cullen McMahon (TL-S), Joel Brown,
Steven Gordon, Ethan Ritz (S),
Aaron Guillen (TL-F)

The Emerson/White Rodgers clinic team was tasked with designing a pattern recognition method that converts spectral flame properties into a measure of the combustion efficiency of a residential furnace, and a control scheme that can use this information to increase the efficiency of any furnace by optimizing the amount of oxygen supplied to the system. A testbed was constructed to collect experimental data and assess various control and pattern recognition schemes.

ENGINEERING/PHYSICS CLINIC

Lawrence Livermore National Laboratory (LLNL)

Axion Dark Matter Experiment (ADMX)

Liaisons: Gianpaolo Carosi, Darin Kinion
Advisors: Richard Haskell, Carl Baumgaertner
Students: Nicole Crisosto (TL-S), Oliver Hoidn,
David Rolfe, Matt Streshinsky (TL-F),
Maximillian Gonzalez (S)

The Axion Dark Matter Experiment (ADMX) clinic project is sponsored by Lawrence Livermore National Laboratory (LLNL) to develop a piezoelectric rotary drive system. This drive system will move tuning rods within a microwave cavity to adjust the cavity's resonant frequency as it scans for signatures of axion dark matter. The system must be able to operate with heat generation on the order of 100 microwatts or less at 0.1 K in an 8 T magnetic field and 10^{-6} Torr vacuum.

Lawrence Livermore National Laboratory (LLNL)

Photocathode Optimization for a Dynamic Transmission Electron Microscope

Liaisons: Dr. Thomas Lagrange,
Dr. Bryan Reed '92

Advisor: Richard Haskell

Students: Tim Nguyen (TL-S), Perry Ellis (TL-F),
Zeke Flom, Spencer Tung (S),
Karen Heinselman (F)

LLNL has asked the team to design and build a test bed to investigate the effects of various factors on the beam quality of an electron gun. The team has constructed a test bed prototype and aims to characterize the electron beam emitted from a photocathode as a function of the incident laser beam characteristics, the material of the photocathode, the distance between the photocathode and the anode, and the voltage difference between the photocathode and the Wehnelt.

Lawrence Livermore National Laboratory (LLNL)

Cryogenic Insulation Design for Liquid Hydrogen Automobiles

Liaison: Gene Berry

Advisor: Joseph King

Students: Brandyn Carlson (TL), Bonnie Gordon,
Mary Bush, Andrew Jennings (S),
Kevin Tham (S), Nick Hill (F),
Chris Abella (F)

Liquid hydrogen fuel enables a uniquely clean and compact fuel source for automobiles, yet it boils easily and can lead to substantial fuel evaporation due to heat transfer to the tank. HMC's clinic team is responsible for characterizing the modes and paths of heat transfer to a subscale cryogenic tank of liquid nitrogen, and to use these results to design, build, and test an optimized insulation prototype and to make recommendations for LLNL's next generation liquid hydrogen tank design.

National Renewable Energy Laboratory (NREL)

Getting Dirty: A Testing Approach to Soiling in Concentrating Solar Power Plants

Liaison: Cheryl Kennedy, Ph.D.

Advisor: Alfred Kwok

Students: Julia Diaz (TL-F), Sam Keene (TL-S),
Ashley Nelson, Evann Gonzales (F),
Dalar Nazarian (S), Ethan Susca (S)

Concentrating Solar Power plants use large mirrors to concentrate sunlight and convert the thermal energy collected to electricity. Over time, these mirrors become dirty from exposure to airborne soil, and this greatly reduces the efficiency of power generation. The NREL team's goal is to create a piece of laboratory equipment which allows for accelerated testing of mirrors and anti-soiling coatings, and to research the properties of desert soil that pertain to adhesion.

GLOBAL CLINIC

India/Birla Institute of Technology Economical Solar Thermal Storage System for Rural Communities of India

Liaison: Dr. Gordon Pickett

Advisors: Anthony Bright, Lisette dePillis

Students: Jennifer Lee (TL-S),
Andrew Xue (TL-F),
Hufsa Ahmad (TL-SU),
Julie Lapidus (Scripps),
Niger Washington (Pomona),
Allie McDonnell (F)

Undergraduate students from Harvey Mudd College and Birla Institute of Technology, Ranchi worked together to find an energy storage solution for rural communities in Jharkhand, India that do not have access to a centralized power grid. The team's final design collects low-grade heat from the sun for diurnal and seasonal use, and powers simple everyday applications like lighting or cooking. The HMC students designed the seasonal component of the system, which stores thermal energy in a large volume of soil underground.

Bio-Rad Laboratories/National University of Singapore (NUS)

Novel Technologies for Protein Separations

Liaisons: Lee Lomas, Matthew Latham

Advisor: Todd Clements '97

Students: Heather Audesirk (TL-S),
Winfong Lee (TL-F), Alix Chan,
Weilu Dai (NUS-TL),
Hannah Lim (NUS),
She Yah Lim (NUS)

The Bio-Rad Global Clinic team is investigating isoelectric point-based protein separations using solid-state buffers (SSB). This process has applications in disease diagnosis and cancer research, so we aim to separate proteins from samples including *E. Coli*, plasma and cancer cells. The team seeks to develop optimized protocols for the use of SSB, and to design, build and test a prototype device that is compatible with the SSB, with the eventual goal of producing a marketable laboratory instrument.

Operation Hope Foundation/National University of Singapore (NUS)

Micro Vegetable Processor and Packager for Poor Rural Vegetable and Fruit Farmers in Developing Countries.

Liaison: Robert Kee

Advisors: Patrick Little, Dejian Huang (NUS),
Philippe Adam (BCF)

Students: Erin Partlan (TL-S),
Aggie Szymanska (TL-F),
Roque Muna (TL-SU),
Richard Coronado (S),
Nobuhiro Yokote (S),
Zhujun Bing (NUS,TL),
Hui Ling Chung (NUS), Jing Gao (NUS)

The team has designed a portable vegetable processor and packager to be used in rural Cambodia by small-scale farmers. The purpose of this project is to give vegetable farmers the ability to generate additional income by making ready-to-eat food pouches with a minimum shelf life of six months. This will eliminate their need to sell their vegetables within a week after harvesting and provide an alternative to selling just raw produce. The processor design utilizes a retort to sterilize food that is packaged into heat-sealed pouches. This project is also funded by the Beckman Coulter Foundation, a charitable organization associated with Beckman Coulter, Incorporated.

MATHEMATICS CLINIC

Space Systems/Loral (SS/L)

Application of Robust Control to Spacecraft Attitude Stability

Liaisons: Saghir Munir, Sophia Huynh '05,
Xen Price, Gerrit van Ommering

Advisor: Rachel Levy

Students: Jake Bouricius (PM), Maxwell Lee,
Andrea Levy, Margaret Rogers

Geosynchronous communications satellites must be precisely pointed to ensure proper payload delivery. The team was tasked to explore modern control theory including multiple-input/multiple-output techniques to improve the fidelity of the feedback control system for spacecraft attitude. The control system is designed to minimize the system's response to actuator and sensor noise. The team will provide simulation data and performance indicators as experimental and theoretical justification for the improved control system.



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