

39TH  
ANNUAL

SANTA CLARA UNIVERSITY



SCHOOL OF ENGINEERING

CONFERENCE 2009

BIOE. CIVIL. COMPUTER. ELECTRICAL. MECHANICAL



MAY 7, 2009

# 2009 SENIOR DESIGN CONFERENCE

## Dear Students, Alumni, Community Partners, and Friends,

Welcome to the 39th Annual Senior Design Conference. We are delighted to have you here as witnesses to the future of engineering.

In today's presentations you will see how our students' work reflects our mission to educate engineers of excellence in both technical ability and ethical behavior. In working on their year-long projects, our students have been measuring everything from the durability of nanostructures, to saltwater infiltration in California's aquifers, to gene expression. They have formulated materials and processes for affordable housing in Africa, water treatment in India, and sustainable irrigation at a Bay Area science camp. Solar, wind, and tidal energies were researched, new techniques for cauterizing varicose veins were discovered, and Web-based learning tools for mentally challenged adults were designed.

In educating our engineering students, we strive to inspire the head and the heart to guide the hands toward action that will directly improve the lives of many, and we are grateful for your contributions in helping us realize this goal. We invite you to enjoy this day as we share our pride in these exceptional senior engineering students and the work they have accomplished.

Sincerely,



Godfrey Mungal, Dean  
School of Engineering



Kathryn Kale, Executive Director  
Alumni Association

## Thursday, May 7, 2009 Program Schedule

- |                       |   |
|-----------------------|---|
| <b>11:30 a.m.</b>     | <b>Judges' Registration</b><br>California Mission Room, Benson Center   |
| <b>12:15 p.m.</b>     | <b>State of the School Address</b><br>Godfrey Mungal, Dean<br>School of Engineering<br>California Mission Room, Benson Center   |
| <b>1 p.m.</b>         | <b>Judges' Orientation</b><br>Godfrey Mungal, Dean<br>School of Engineering<br>Kathryn Kale, Executive Director<br>Alumni Association<br>California Mission Room, Benson Center |
| <b>1:30–4:30 p.m.</b> | <b>Senior Design Presentations</b><br>Engineering Center and<br>The Harrington Learning Commons,<br>Sobrato Technology Center, and Orradre Library                              |
| <b>4:30–5 p.m.</b>    | <b>Demonstrations</b><br>Engineering Quad   |
| <b>5 p.m.</b>         | <b>Banquet</b><br>Bannan Engineering Laboratories and<br>Engineering Quad   |



## **CIVIL ENGINEERING SESSION 1: Learning Commons and Library Viewing and Taping A, Room 129**

### **Cold-Formed Steel Design for 2009 Solar Decathlon House**

**1:45–2:15 p.m.**

*Jai Master, Tim Quan, Trenton Zane*

*Advisor: Reynaud Serrette*

Redesigning Santa Clara University's 2009 Solar Decathlon House using cold-formed steel as the primary construction material. This project features the structural and foundation design as well as a cost analysis that compares wood and steel as structural and environmentally-sustainable materials.

### **Engineers Without Borders 31 De Augusto Bridge**

**2:20–2:45 p.m.**

*John Beadle*

*Advisor: Reynaud Serrette*

The design and management of a 60-foot, two-lane bridge with the intention of simplifying construction and maintenance. This project is in contingency with the San Jose Engineers Without Borders professional chapter's Honduras bridge project.

### **Prefabricated Emergency Homes**

**2:50–3:15 p.m.**

*Chris Haley, Maria Jarrell*

*Advisor: Reynaud Serrette*

Design of a prefabricated lightweight gauge steel home to be shipped to sites recently ravaged by natural disasters. Shipping logistics, estimated cost, and analysis of members to assure their adequacy will be presented.

### **Sustainable Engineering Center of the Future**

**3:25–3:55 p.m.**

*Juan Carlos Esquivel, Andrew Kellen,*

*Allen McDermott*

*Advisor: Reynaud Serrette*

The structural and foundation design of a new engineering facility for Santa Clara University to house each engineering discipline. The structural design will be determined by factoring

in all pertinent loads such as wind, dead, and live loads. The design of the facility will also be aimed at achieving a minimum of LEED silver certification and will show a cost-benefit comparison between the LEED-certified facility and a non-certified facility.

### **2009 ASCE/AISC Student Steel Bridge Competition**

**4–4:25 p.m.**

*Anthony Galvan, Brian Reeves*

*Advisor: Reynaud Serrette*

All competing schools were asked to submit a 1:10 scale model to demonstrate their concept of a bridge to be replaced. Models were erected under simulated field conditions and then load tested. A panel of judges evaluated the models for durability, constructability, usability, stiffness, construction speed, efficiency, economy, and display.

## **CIVIL ENGINEERING SESSION 2: Learning Commons and Library Viewing and Taping B, Room 133**

### **2009 Solar Decathlon: Structural Design and Construction Management**

**2–2:30 p.m.**

*Sean Irwin, Daniel Ruffoni, Andrew Smith*

*Advisor: Mark Aschheim*

The project focuses on the structural design and construction management of the SCU Solar Decathlon entry for the 2009 U.S. Department of Energy competition, and includes the testing and qualification of bamboo open-web joists used for the roof framing.

### **Green Buildings in Ghana**

**2:35–3:05 p.m.**

*Betsy Leaverton, Jessica Long, Julianne Padgett*

*Advisors: Mark Aschheim, Sukhmander Singh*

This project aims to improve rural village housing in Northern Ghana with respect to financial feasibility, local resources, sustainability, and cultural acceptance. Innovative earth architecture was explored in a site visit to Ghana and alternatives were developed to standardize quality building practices in the region.

### **Shear Strength of Plasters Used in Straw Bale Construction**

**3:15–3:40 p.m.**

*Andrew Aberg*

*Advisors: Mark Aschheim, Sukhmander Singh*

Testing and analysis of plaster panels in shear to develop design values for straw bale wall construction under wind and seismic loads.

### **Soil Stabilization for Burj Dubai**

**3:45–4:10 p.m.**

*Alexander Kneefel, Masood Sattari*

*Advisor: Sukhmander Singh*

This project focuses on the foundation design for the Burj Dubai Tower located in Dubai, UAE. It is our assertion that by using geotechnical innovations, soil strength will increase. This will allow for a more efficient and shallower foundation design.

## **CIVIL ENGINEERING SESSION 3: Learning Commons and Library Training and Instruction 1, Room 203**

### **Greenhouse Distill**

**1:45–2:10 p.m.**

*Brand Schlesinger*

*Advisor: Edwin Maurer*

By using a greenhouse for distillation, a pond of recycled or salt water can be transformed to pure drinking water. The ponds of "dirty" water will act as heat collectors, keeping an ideal environment for some plant life. The resulting humidity will sustain the plants in a clean manner with little maintenance required, essentially creating a terrarium.

### **Salt Water Intrusion in the Salinas Valley**

**2:15–2:45 p.m.**

*Natalie Diaz, Peter Hoseit, Garrett Kaprielian*

*Advisor: Edwin Maurer*

Overpumping has caused saltwater to infiltrate the Salinas Valley aquifers since the 1930s. Heavily dependent upon groundwater to meet agricultural water demands, "America's Salad Bowl" could be permanently damaged unless a solution is found. We use a state-of-the-art numerical groundwater model to explore solutions to this problem.

### **ITS of Lafayette Street**

**2:50–3:15 p.m.**

*Stephen Archer, Peter Nguyen*

*Advisor: Rong (Rachel) He*

Reevaluating the design of Lafayette St. from the intersection of Poplar St. to El Camino Real. The project observes existing traffic to see how important the reverse lane is to traffic flow. Additions of bicycle lanes and extra pedestrian walkways to increase safety and to see how both affect traffic are also considered.

### **South Bay Tidal Micro-Hydropower Plant**

**3:25–3:50 p.m.**

*Daniel Bates*

*Advisor: Edwin Maurer*

Tidal power provides consistent, dependable, predictable, and renewable energy that needs to be harnessed. Combining traditional concepts and technology in an unorthodox way allows for optimizing performance and minimizing costs, both economic and environmental.

### **Synchronization of Traffic Signals on San Tomas Expressway**

**3:55–4:20 p.m.**

*Ryan Yelinek*

*Advisor: Rong (Rachel) He*

This project models changing the timing on the current traffic signal system located on San Tomas Expressway, taking into account the different traffic demand at various sections on the Expressway, and the impact the synchronization has on surrounding neighborhoods.

## COMPUTER ENGINEERING SESSION 4: EC 618

### Educational Tool for Finances 1:30–2 p.m.

Marco Echandi, Jason Goetsch, James Lewis  
Advisor: JoAnne Holliday  
A Flash program designed to familiarize mentally challenged adults with daily financial tasks.

### First Place Learning 2:05–2:30 p.m.

Jose Delgado, Debra Mortensen, Sean Schiff  
Advisor: JoAnne Holliday  
A Web-based learning tool that intends to solve the incompatibility issue between mentally challenged adults and the childish learning tools that are currently presented to them. The program is designed specifically for them, at their age, around themes that engage their interests and attention.

### H.264 3D Video Encoding 2:35–3 p.m.

Jacob LaPinta, Jonathan Le, Jaipal Nijjar, Eamonn Pascal  
Advisor: Nam Ling  
Using JSVM to create a user-friendly application that will implement the multiview coding aspects of the software, this application will take inputs of a video shot from several angles in order to output an optimally compressed 3D video according to the user's preferences.

### NoteFlash 3:10–3:40 p.m.

Jon Azoff, Cameron Boehmer, Ben Cherry  
Advisor: Dan Lewis  
The NoteFlash website provides users with a rich text interface for taking notes in settings from the lecture hall to the board room. As the user types, NoteFlash will provide the user with snippets from related documents in the NoteFlash database that can be used as reference or included directly in the user's own notes.

### Secure Teacher Evaluation Submission System (STESS) 3:45–4:10 p.m.

Jack Qiang  
Advisor: Thomas Schwarz, S.J.  
Teacher evaluation submission system that utilizes security principles and protocols. A precursor to online/e-voting systems.

## ELECTRICAL ENGINEERING SESSION 5: EC 602

### Black Mamba Varicose Vein Treatment: Simplifying a Medical Treatment 1:45–2:15 p.m.

Claudia Andrade, Ben Buford, Stacy Cavanagh  
Advisor: Shoba Krishnan  
This project involves the design of a battery-operated, cordless medical device for varicose vein treatment. The Black Mamba generates enough power to heat a catheter and provides controlled feedback for temperature regulation. Our goal is to simplify the Closure Fast design of VNUS medical technologies to make the medical procedure more convenient and cost effective.

### Contact Resistance Extraction of Carbon Nanotubes 2:20–2:45 p.m.

Ke Li, Raymond Wu  
Advisor: Shoba Krishnan  
The technique of creating and measuring the contact resistance of vertical carbon nanotubes.

### Sunflower: A Solar-Powered Water Pumping System 2:50–3:20 p.m.

Maurvi Badshah, Colleen Kilroy, Brahmani Nandamuri  
Advisor: Shoba Krishnan  
To meet the irrigation needs of local outdoor school and science camp Walden West, a solar-powered water pumping system was developed. This community-based project includes a hands-on educational model to demonstrate the importance of sustainability and engineering to fifth- and sixth-grade students.

### A Study on Quantum Capacitance and Kinetic Inductance in Nanostructures 3:30–3:55 p.m.

Navid Akhavan Tafti  
Advisor: Toshishige Yamada  
We study quantum capacitance and kinetic inductance in nanostructures, especially carbon nanotubes (CNTs). Their physical origins are examined and their expected values for a CNT with given specifications are predicted. It is shown that these elements have appreciable influences only in special circumstances, and such conditions are clarified.

### Electrical Breakdown of Carbon Nanofibers Due to Joule Heating 4–4:25 p.m.

Zefram Marks  
Advisor: John Jameson  
Carbon nanofibers (CNFs) are being studied for interconnects in ICs. CNFs fail when a high current induces joule heating in the CNF, causing breakdown. To characterize this, the breakdown current is measured for CNFs at various temperatures to see what effect this has on the breakdown current.

## MECHANICAL ENGINEERING SESSION 6:

### Learning Commons and Library Training and Instruction 2, Room 205

### Stereo Thermal Imaging 1:30–2 p.m.

Nick Bass, Katie Kubo, Kevin Pagano, Lucia Polak, Ben Recktenwald  
Advisors: Drazen Fabris, Tim Hight  
A rugged, infrared, stereo camera system was designed to identify the positions of other vehicles and obstacles during dusty and dark environments for the Volkswagen Baja 1000 race truck.

### Genentech Packaging System 2:05–2:35 p.m.

Glenn de Castro, Amit Patel, Patrick Riley, Matthew Walker  
Advisor: Tim Hight  
Modifying the current in-feed section of the packaging line at Genentech, replacing the feed-screw with a vial twist mechanism and cog wheel, reduces vial scratches and rejection rate.

### Hydro Garden 2:40–3:10 p.m.

Muhammad Rahbar, Matt Spevak, Tim Tri  
Advisor: Tim Hight  
Recognizing the importance of efficient food production and the decreasing amount of petroleum, our goal is to design and test a hydroponic garden built out of sustainable bioplastics to produce a significant food yield quickly, without the use of soil and with minimal water usage.

### Autonomous Solar Cleaner - WinRobo2.0 3:20–3:50 p.m.

Riley Coon, Robert Lorenzen, Tyler Petersen, Kyle Pistor  
Advisor: Tim Hight  
WinRobo2.0 is aimed at preventing power loss on solar arrays due to the accumulation of particulate matter. The goal is to provide a convenient, reliable, and cost-effective solution to clean residential solar arrays in dusty environments.

### Wind Turbine Winglet Design 3:55–4:25 p.m.

Megumi Mori, Eric Pelfrey, Eric Shono  
Advisors: Drazen Fabris, Tim Hight  
The purpose of this project is to design a winglet for application on PowerWorks KCS56 wind turbines to help determine if winglets are a practical solution to increasing turbine power output. This project focuses on an extensive engineering analysis using computational fluid dynamics and finite element analysis.

## INTERDISCIPLINARY SESSION 7: EC 325

### Remote Home Monitoring System 1:30–1:55 p.m.

Nick Treat  
Advisor: Silvia Figueira  
The Remote Home Monitoring System is a small-scale device capable of monitoring a small area. The Ethernet connection allows this device to be connected to a network. The device can be monitored remotely, and settings on the device, such as desired room temperature, can be changed remotely, as well.

## Anti-Theft Device for Solar Panels

2–2:25 p.m.

*Thomas Kennedy, Mark Swoboda*

*Advisor: Timothy Healy*

A 24-hour anti-theft system for solar panels that uses sensors and switches to detect theft is incorporated into Act Solar's existing solar monitoring system.

## Solar Hybrid PV/T

2:30–3 p.m.

*Colin Abraham, Lisa Lahman, Kevin Nunes, Nathan Parnell, Joseph Republican, Jacob Rios, Eric Vonderhaar*

*Advisors: Timothy Healy, Tim Hight*

Team Solar Hybrid PV/T is working with EnFocus Engineering Corp. to lower the operating temperature of EnFocus' concentrated photovoltaic module to increase electrical output. Our goal is to design a cooling system that both lowers the temperature of the photovoltaic cells and harnesses the heat drawn from the cells.

## Thermal Systems for the 2009 Solar Decathlon House

3:10–3:45 p.m.

*Matt Brubaker, Rob Flores, Zach Maslin,*

*Jeff Seago, Tim Sennott, Dan Skavdal*

*Advisor: Tim Hight*

The design and implementation of a solar thermal heating, cooling, and hot water system for the 2009 Team California Solar Decathlon entry. Design focus is intended to showcase innovative new technologies like solar radiant cooling, as well as optimize comfort and flexibility while still using an absolute minimum of energy.

## EWB Solar Thermal Water Purification

3:50–4:25 p.m.

*Davis Fogerty, Ross Ruecker, Robert Housley*

*Advisor: Tim Hight*

A solar thermal heated, vacuum-assisted distillation process capable of purifying brackish water at 30,000 ppm to potable water at 10 ppm for Karheda, India. The project was adopted from a 2007–08 senior design team that created a functional proof of concept model. Original project presented by Engineers Without Borders and the Sehgal Foundation.

## INTERDISCIPLINARY SESSION 8: EC 326

### OBSIDIAN Nanosatellite Biosystems Design

1:45–2:10 p.m.

*Elizabeth Doran, Rafael Ramirez*

*Advisor: Christopher Kitts*

The purpose of this project is to design the biological payload components for the OBSIDIAN nanosatellite, including the design and testing of the microfluidics system and testing of the payload's existing image-capturing system through a biology experiment involving the expression of Green Fluorescent Protein in yeast.

### CSCADE: An Extensible Architecture for Robotics Research

2:15–2:40 p.m.

*Eric Rowe, Jeffrey Steinhilber*

*Advisor: Christopher Kitts*

CSCADE (Controller and System Communication Architecture and DataTurbine Engine) is used for communication between the hardware level of a distributed experimental system and a high-level controller. It simplifies controller design by promoting the reuse of components across multiple experiments and configurations.

### OBSIDIAN Power Subsystem

2:45–3:10 p.m.

*Alejandra Rojas, Yu Chi Woo*

*Advisor: Christopher Kitts*

The Electrical Power Subsystem (EPS) provides power to the satellite. Consisting of two circuit boards—a power regulating and an inhibits board—it also includes solar panels and batteries that are used to generate, store, and deliver power to maintain life support for the entire satellite.

### OBSIDIAN Wireless Communication System

3:20–3:45 p.m.

*Jeffrey Chao, Scott Tsutsumi*

*Advisor: Christopher Kitts*

The goal of this project is to integrate a wireless communication system that will allow the ground station to control operations onboard the OBSIDIAN nanosatellite, including data transfer, control systems, and telemetry.

## Nanosatellite Mechanical Design and Analysis

3:50–4:25 p.m.

*Emmanuel Aparicio, Katherine Byrne, TJ Leising,*

*Jason Takisaki, Reyn Wakabayashi,*

*Anthony Young*

*Advisor: Christopher Kitts*

This project is an exhibition of the Robotic Systems Laboratory's mechanical design and analysis capabilities developed for the structure, thermal, and attitude determination and control subsystems of nanosatellite-class spacecraft. These capabilities have been improved through this year's work on the OBSIDIAN, mini-IRIS, and IRIS nanosatellites.

## INTERDISCIPLINARY SESSION 9: Learning Commons and Library St. Clare Room

### Program for Data Acquisition: Measuring Gene Expression

1:45–2:10 p.m.

*Jason Buenrostro, Michelle Mattson*

*Advisors: Craig Stephens, Justen Whittall*

Quantitative real-time PCR (qRT-PCR) is a tool used to quantify gene expression. Through the development of several assays, we have designed a universal protocol for various organisms. The protocol provides a fast, accurate, and affordable method, taking full advantage of the capabilities of qRT-PCR for research.

### Swarm of Brian: Enhancing TrackBot's Application Code

2:15–2:40 p.m.

*Brian T. Jenkins*

*Advisor: Silvia Figueira*

The TrackBot application code, an educational robotics platform, is enhanced to provide a simpler Java API for an extensible TrackBot base class. Bump sensing and other features are implemented as demonstrations of these enhancements. Additionally, a Swarm Java API is created that can be extended, implementing autonomous, collaborative swarming behavior among multiple TrackBots. A swarm simulation is also implemented based on the Swarm Java API.

## Nephelometer: An Aerosol Detection Device

2:45–3:15 p.m.

*Karen Chapski, Lauren-Ashly Tojo, Frances Zelaya*

*Advisors: Tim Hight, Sarah Kate Wilson*

The nephelometer measures Aerosol Optical Depth while airborne. It is designed for use by NASA scientists to aid in low-cost, lightweight, and low-full data acquisition. The nephelometer will replace the current tool, a sun photometer, to solve a major issue faced by those scientists: aerosol data gained from satellites does not match data samples taken from the ground on the West Coast.

## Seismic Shake Table

3:25–3:55 p.m.

*Michael Hofman, Chris Leatham, Adam Wong*

*Advisors: Mark Aschheim, Darren Atkinson,*

*Tim Hight, Christopher Kitts, Terry Shoup*

A dual-drive shake table that will be used for simulating past earthquake data and performing satellite testing. The satellite application will perform a sweep at varying frequencies in an attempt to identify the resonant frequency.

## SWATH Boat

4–4:25 p.m.

*Thomas Blozis, John Fisher*

*Advisor: Christopher Kitts*

The SWATH, small waterplane area twin hull boat, is an autonomous platform for bathymetric mapping of bodies of water using sonar. A doppler velocimeter logger and an attitude and heading reference system to increase the accuracy of the bathymetric maps are also incorporated.

# 2009 SENIOR DESIGN JUDGES

We wish to thank the following alumni, friends, and industry partners whose participation as judges contributes greatly to the success of the Senior Design Conference.

## CIVIL:

Jeff Abercrombie  
California  
Department of  
Transportation

Patrick Arevalo  
Rudolph & Sletten

Cathy Avila  
Avila and Associates  
Consulting  
Engineers, Inc.

Ernie Avila  
Avila and Associates  
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Dominic Boitano  
Boitano Affiliated

Bob Fassett  
Pacific Gas and  
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eRide, Inc.

Chris Brady  
Stanislaus County  
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Alberto Cruz  
Mead & Hunt, Inc.

Nayana  
Dawalbhakta  
GridIron Systems

Jackson Dovey  
XL Construction

Jim Foley

Matthew Foley  
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Engineering and  
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Eric Golangco  
Golangco Global

Richard Grabinski  
Flatiron West, Inc.

Joseph Harkins  
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John Hopkins  
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Matt Marino  
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Anthony Mei  
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Richard Weber  
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Ryan Becker  
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Erik Burd  
Restoration  
Robotics

Victoria Coleman  
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Karl Hennig  
iControl Networks

Sheila Johnson  
Lockheed Martin

Michael Kacirek  
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SiGe  
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Mitchell Chan  
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John Dacquisto  
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Owens Design

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David Weldon  
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Haig Yengoyan  
Lockheed Martin

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Prequel, Inc.

Robert Komoto  
American Products  
International

Gordon Lui  
EFI

Dale Schockley  
D&S Consulting

Scott Starks  
Hewlett-Packard

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Ed Weldon

William Boenig  
Vnus Medical  
Technologies



**Santa Clara  
University**

School of Engineering

[www.scu.edu/engineering](http://www.scu.edu/engineering)

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