



NUTS & BOLTS

Contents

GAME Orientation Week	1
Message from the President	2
ME Grad Shop & Tool Sale	3
Old School or OLD School?	4
GAME Website	5
Changing Hubs, Changing Lives	6
Faculty Profile: David Wallace	8

GAME Officers

President: David Quinn
Vice President: Barry Kudrowitz
Secretary: Mats Cooper
Treasurer: Anjuli Appapillai

GAME Chairs

Coffee: Raul Coral Pinto
IM Sports: Will Becker
Machine Shop: Lael Odhner
MEGAWomen: Amy Banzaert
Orientation: Bridget Revier
Ryan Griffin
Publications: Amy Banzaert
Social: Danielle Zurovcik
Tech. Tours: Danielle Chou
Webmaster: Nader Shaar

2004-2005 GSC Reps

Will Becker Stacy Figueroa
Raul Coral Onnik Yaglioglu

2005-2006 GSC Reps

Deep Ghosh Steven Peters
Amit Gupta Simon Watson

Nuts & Bolts Editor in Chief
Amy Banzaert



GAME Orientation Week

By: Ryan Griffin and Bridget Revier
GAME Orientation Chairs

GAME orientation week started with an overabundance of food at the "Meet Your Mentor" brunch. Thanks to fantastic, early-rising volunteers, about 100 incoming grads and current students indulged in eggs, sausage, pancakes, hash browns, fruit, pastries, juice, and coffee.

The next day, 20 MechE grads rode to Lexington and back, working off the huge brunch from the day before. The trip was 27 miles roundtrip and the group's average speed was 10.5 mph. Along the way, the group enjoyed ice cream in Lexington, patched two flat tires, and found one ~~lost~~ misplaced orientation chair.



To combat the warm summer weather on "Frosty Saturday," 35 of us headed to the Sam Adams brewery tour and learned about the art of brewing and the art of beer tasting. Later in the day, we took our newly acquired tasting skills and put them to the test on a pub crawl through Boston. The crawl started early, with a special opening of the Thirsty Ear Pub by GAME's own orientation chairs, followed with visits to Crossroads Pub, Cactus Club (with a long wait to get in), Pour House, and Whiskey's, culminating with a bit of dancing at Daisy Buchanan's.



Sunday was a lighter day for those recovering from the testing of their tasting skills. In spite of a freak freezer unplugging/sabotage, there was plenty of ice cream and fun toppings to go around at the ice cream sundae party.

The Harbor Islands trip was possibly the highlight of GAME orientation week. We had 54 people join in for fort exploring, games of catch, frisbee, and lots of sun.



We would like to thank everyone who participated in all of the events for making this year's orientation so fantastic and for making all of our planning worth it. It was so good, in fact, that we had first year grads from other departments crashing our parties.

Message from the President



Well into another year of “GAMEing” at the institute, I felt our fall issue of *Nuts and Bolts* would be a good opportunity to offer some reflection on the time I have spent here thus far, where I think we (GAME) have been, and where we are going. Beginning the third of N years, I am still in awe of what goes on across all of MIT and, more specifically, within the Department of Mechanical Engineering. With the diversity of high impact intellectual pursuits that take place here, one can't help but be a little disappointed that we, as individuals, only have the time and energy to focus on such a relatively small portion of the bigger picture.

Despite this slight letdown, we should ultimately consider ourselves blessed to be part of this process. We should also consider ourselves blessed to have the opportunity to interact with each other: despite our varied backgrounds and experiences, we are unified by our passion for our chosen fields and the mere fact we are at this place at the same time. GAME exists for the purpose of building upon these similarities: to foster a supportive, communal environment within the MechE department. In just its fourth year of existence, GAME has established a core of social functions that help to promote this sense of community, highlighted by events that include a student seminar series, weekly coffee hours, monthly social hours, BBQs, ski trips, a winter party, and technology tours. These community-building social events have been supplemented with advocacy and assistance initiatives

related to qualifying exams, facilities in the department (see this issue's article on the Grad Machine Shop), and the establishment of a mentor program for new students.

GAME is forever indebted to the people who helped establish the group and to those who served on its first two elected executive committees: Tarek El Aguzy, Krishnan Sriram, Sofy Tarud, Matt Traum, Jennifer Topinka, Joe Acar, Nici Ames, Kate Thompson, Conor Walsh, and many others. Building upon their work and extending these initiatives, especially related to advocacy in important areas such as qualifying exams, is the major goal of my term as GAME president.

It is sometimes easy to lose ourselves in our work, walk down the infinite corridor with iPods on and our heads down, and forget about the people outside of our respective labs. But I think that even something as simple as spending 15 minutes at a weekly coffee hour and talking to, even venting with, others who share the same experiences will have a huge impact on our daily outlook. We hope that we have helped provide such opportunities with the work we have done thus far. GAME continues to strive to support its 500+ member constituency, and we ask for your participation and input in the process. We welcome your feedback, by emailing <game-officers@mit.edu> or voicing your concerns to us at events; additionally, we always appreciate volunteered assistance. I remain convinced that few things cannot be improved without the right amount of personnel and persistence. Whether you are in your 1st or Nth year, there is a lot we can learn from each other. And I am comfortable speaking for the rest of our executive committee when I say that it is an honor for us to serve all of you in our positions. Good luck in the rest of the semester.

Dave Quinn

Upcoming GAME Events

- ◆ 11/10: GAME Happy Hour
- ◆ 11/18: Qualls Info Session (hosted by MEGAWomen)
- ◆ 12/14: GAME Happy Hour
- ◆ 12/17: GAME Holiday Party
- ◆ Lunch Seminars Alternate Thursdays @ 12
- ◆ Coffee Hour Fridays, 8:30-10
- ◆ GAME/13 Seas Tea Hour Wednesdays @ 3

For details and more events, see: web.mit.edu/game

Email game-request@mit.edu to get on the GAME email list.

◆
Concerned about GSC issues? Email your MechE GSC Rep: game-gsc-rep@mit.edu

◆
Concerned about MechE issues? Email game-exec@mit.edu

MechE Grad Shop & Tool Sale

The MechE Grad Shop is Calling

By: Lael Odhner

GAME Machine Shop Chair

Do you remember what you thought engineering would be like when you were a kid? I remember looking at fast cars and pictures of welding robots and giant steel mills on TV, all the while thinking, "Wow! I want that!" Alas, we get to grad school and find that the halcyon days of big engineering are in the past, and buzzwords like micro- and nano- are practically required for research to be cool. We gaze wistfully into our Petri dishes, MEMs wafers, and atomic force microscopes, pining for the day when we could go out and build something!! Well, help is on the way: the Pappalardo Grad Shop. The Pappalardo Laboratory provides a machine shop for MechE grad students, and YOU are allowed - no, invited - to go and use it.



The Pappalardo Grad Shop is located beneath the south stairwell in building 3, on your right as you come down the stairs. In the shop, we have a full spread of giant steel-munching machines for your enjoyment, including a CNC Bridgeport milling machine. This year, we're also getting a really sweet lathe to replace our two older lathes. All ME (and OE) grad students are welcome to use the shop for research or for personal projects provided you and your advisor sign a copy of the shop agreement form, which you can obtain by asking the staff in the Pappalardo undergraduate shop. You are not required to take a training course at MIT to use the grad shop, but if you are feeling rusty, the Edgerton center offers a class on basic shop skills; you can find out when these are offered on their website: <web.mit.edu/Edgerton/www/Shop.html>.

The shop will be open for more casual instruction on Tuesday nights during the month of October from 6:00 to 9:00 PM. Volunteers will be there with spare material to show you the basics of how to set up and use our machines, and to hand out agreement forms. So come on down and build something!

ASME Call for Papers

- | | |
|----------|---|
| 10/30/05 | 2006 ASME Pressure Vessels and Piping Conference |
| 10/31/05 | 4th International Fuel Cell Science, Engineering, & Technology Conference |
| 11/1/05 | 2006 Joint Rail Conference |
| 11/3/05 | 2006 ASME Power Conference |
| 11/3/05 | 9th AIAA/ASME Joint Thermophysics and Heat Transfer Conference |
| 11/10/05 | 2006 Engineering Systems Design and Analysis Conference |
| 1/16/06 | International Conference on Nuclear Engineering |

Tool Sale a Big Success

By: Lael Odhner

GAME Machine Shop Chair

On registration day, GAME held a surplus tool fundraiser in the Pappalardo lab during the departmental brunch. News traveled fast: within an hour of opening, we were sold out, raising nearly \$1000 for this year's GAME budget. Special thanks go to Dick Fenner for arranging the donation of used and spare tools, and for providing table space in the Pappalardo Lab for the sale.

Old School or OLD School?

By: **Matthew J. Traum**
GAME Co-Founder

In the eyes of MIT's newest clutch of mechanical engineering graduate students, my status as a fifth-year grad student probably makes me appear a bit dated, dare I say, old school. After all, when I first arrived at MIT, the Stata Center was a dusty pre-construction pit, Ocean Engineering was still its own department, and the Graduate Association of Mechanical Engineers (GAME) had not yet been conceived. However, the changes I have witnessed to the campus and the Department during my time at MIT reveal only an iota of MechE's remarkable history and its impact on many other facets of the Institute. MIT might be an OLD school, but with our venerable age comes a rich history and heritage, along with some quirky attributes. A quick perusal of the MIT Library's Institute Archives reveals many interesting anecdotes concerning the history of the Mechanical Engineering Department including the following bits garnered from libraries.mit.edu/archives/mithistory/histories-offices/mecheng.html.

When MIT opened its doors in 1865, mechanical engineering was designated as Course I. In 1872, the honor of being MIT's first course was usurped by Civil Engineering and MechE took on its now-familiar designation as Course II. Mechanical engineering became a formal MIT department in 1883. At that time, the following eclectic concentrations were offered: marine engineering, locomotive engineering, and mill engineering. By the turn of the century, heat & ventilation and steam turbine engineering were added. By 1918, all of these programs had been discontinued. The MechE Department's specialization in naval architecture spun off in 1894 to become its own department, naval architecture. Ironically, naval architecture (which became the Department of Ocean Engineering) was re-absorbed by Mechanical Engineering 111 years later.



OLD school MIT drafting class
web.mit.edu/museum/exhibitions/main.html

When MIT moved across the Charles River from Boston's Copley Square to its new Cambridge home in 1916, someone must have forgotten that engineering had moved along with the rest of the Institute. The famous Institute moniker carved into the Lobby 7 dome inside the 77 Massachusetts Ave. entrance declares that MIT was "established for advancement and development of science, its application to industry, the arts, agriculture and commerce." Engineering is not mentioned, despite being central to MIT's 1916 curriculum; architecture was also overlooked.

The year 1933 witnessed the incorporation of aeronautics classes into the mechanical engineering curriculum. The traditional hydraulics course was modified to encompass the mechanics of fluids. This curriculum shift underpins MechE's flagship graduate fluids course, 2.25: Advanced Fluid Dynamics. While more MechE graduate students take the qualifying exam in fluids than any other subject, the aeronautics courses upon which this subject was originally predicated are no longer within Mechanical Engineering. In 1939, MechE's aeronautical expertise was combined with assets from Naval Architecture to create a new department, Aeronautical Engineering, Course 16. By the mid 1970's, the MechE Department's focus on research for military applications had been eclipsed by quality of life and commercial engineering. Today, all core disciplinary areas of mechanical engineering are represented in Course II, including Dynamics, Controls, Solid Mechanics, Materials, Fluid Mechanics, Transport, Thermodynamics, Design, Manufacturing, Energy, Bioengineering, Information, Nano/Micro-Technology, and Ocean Engineering.



MIT in the 1920s
alumweb.mit.edu/clubs/s-texas/ClubHistory.htm

So, when you see your venerable fifth-year colleagues ambling down the Building 3 hallway try to suppress your desire to chuckle "old school!" under your breath. Remember instead that we are all members of one of the most historically rich and colorful departments at a truly OLD school. The history of MIT is still being written, and we all have a hand in making this heritage quirky and memorable.

GAME Website – More content, more reasons to browse

By: Nader Shaar
GAME Webmaster

In addition to sending out emails to student mailing lists, GAME relies on its website to communicate with its constituency. As of Spring 2005, significant effort has been made to improve the website, starting with the creation of a 'webmaster' as a new officer position in February.

The website's homepage highlights current events organized by GAME and lists the dates of future events. The *Activities* page offers detailed event descriptions and pictures from former activities, grouped chronologically. The successful GAME Lunchtime Seminar Series is allocated a separate section; it lists the schedule for the term's seminars and links to abstracts of individual talks.

The *Resources* section includes links to the ME Graduate Guides, the GAME Newsletter, GAME's annual reports, fellowships leads, housing options, and many other sources of information useful for new and continuing graduate mechanical engineering students.

In addition, a fairly new link to *Forums* is available; the forums are set up on <stellar.mit.edu> and are dedicated to technical topics of interest to mechanical engineering students. The website is also used to conduct surveys, whose results are used to improve the general student life experience of MechE students.

The GAME executive committee is currently working to improve the overall look of the website, and making it more appealing to its viewers. Other efforts are being made to set up common student web pages, similar to those for professors in the department.



A screen shot from the GAME website: <web.mit.edu/GAME>

Get published, without research results!

Write for **NUTS & BOLTS**

Contact game-news@mit.edu

Changing Hubs, Changing Lives: Engineering design of wheelchairs in Tanzania

By: Amos Winter
ME Graduate Student

In the summer of 2005, ME graduate student Amos Winter received a fellowship from the MIT Public Service Center to travel to Tanzania and assess the state of wheelchair technology in the country, so that non-governmental organizations focused on wheelchair development and distribution could improve access to robust, affordable wheelchairs for the people in Tanzania who need them. The Tanzanian Association of the Disabled estimates there are 30,000 people in the country who need a wheelchair, while only 1000 own them. Working with the Tanzania Training Center for Orthopedic Technologies (TATCOT) of Arusha, TZ and Whirlwind Wheelchair International of San Francisco, Amos conducted interviews with wheelchair users and advocacy groups and toured wheelchair manufacturing facilities in areas around Dar es Salaam, Moshi, and Arusha. He also reviewed the TATCOT Wheelchair Technologist Training Course (WTTC) program and literature. The outcome of the project was a report that identifies the specific needs of Tanzania wheelchair users, the current state of technology and design shortcomings of wheelchairs produced in-country, and what material should be included in the WTTC to better prepare graduates for wheelchair production.

My experience in Tanzania was truly fulfilling and life-changing. As an engineer, I found the work extremely compelling and, personally, the trip has transformed my career aspirations. What I found interesting about the project, from an engineering perspective, was that, in order to understand the design changes necessary for improving existing wheelchairs in Tanzania, all I had to do was look and listen. What needed to be changed presented itself naturally from interviews, inspection of chairs, and feedback from wheelchair organizations. I saw hand-powered tricycles that were heavy and bulky but too weak at the points of highest stress. I saw imported chairs rendered useless after breaking one part, because replacements are nonexistent. I saw western-designed chairs, supposedly suited to developing world environments, fail under certain loading conditions.

While such engineering failures were disheartening, I very much enjoyed the process of solving technological wheelchair problems during the study. I found many ways to make the chairs more reliable, less expensive, and easier to manufacture. This exercise was gratifying as a mechanical design problem, as it had many design constraints, such as part availability, cost, ease of production, types of raw materials, and harsh operating environments. My most significant contribution to improving current chair technology was designing a way to replace all parts not available in villages with common bicycle components. The figure below shows how bicycle stem bearings can be used for the rear wheels by making the axle part of the hub and putting the bearings within the frame. Using bicycle bearings



Hub design, before and after, clockwise from top left: Current hub produced in TZ, common bicycle stem bearings, exploded view of bearings used on new hub design, assembled new hub design

improves the design by making the chair stronger with hollow, large-diameter axles; reducing cost; using components that are replaceable at any bike shop; having the bearings in angular contact, which is more appropriate for wheelchair loading; and allowing for the bearings to be disassembled and cleaned, increasing their life.

I love diving into the nitty-gritty of engineering problems, and my project this summer provided many opportunities to do so. I was in my element: scouring the streets for bicycle components that could be used in wheelchairs, coming home and crunching the numbers for life calculations, and determining that the bearings were strong enough to last 10 years with more than 99% confidence. I also love getting my hands dirty. One of the best days of the summer, shown in the pictures below, was when I worked side by side with the technicians at the Disabled Aids and General Engineering (DAGE) workshop, making a prototype of a new hand-crank configuration for their tricycles. Instead of having the hand cranks opposed, we turned one around so both faced the same direction. This configuration prevented pedaling torque from making the front wheel steer back and forth, and also allowed the rider to more effectively use his back and abdominal muscles for power. The two disabled DAGE technicians who rode the prototype agreed that it drove better than their conventional tricycles.



At left: Abdullah and Amos working on hand crank prototype at DAGE, Dar es Salaam.

At right: Abdullah testing prototype at DAGE, Dar es Salaam

The experience I had in Tanzania is helping to shape my career goals. I plan to continue my involvement in the evolution of wheelchairs in Africa. This summer, speaking to wheelchair technicians and reading the TATCOT WTTTC course material, I saw a great need for increasing the mechanical engineering knowledge of people producing wheelchairs. Understanding how to design chairs, not just how to make a given style or model, gives technicians the freedom to improve existing chairs, develop new concepts, and adapt to changing material and part supplies. Next summer, I hope to write a manual on mechanical engineering concepts for wheelchair design and then present the manual at the 2006 Africa Wheelchair Congress in Arusha, Tanzania. In the spring of 2007 I plan to teach a Public Service Design Seminar to design and prototype a next-generation wheelchair for Africa.

As far as life-long effects, living and working in Tanzania has made service learning a priority in the rest of my career. My project had an enormous effect on me culturally, as well as technically. I learned about a society so different from my own while I contributed positively to Tanzania's engineering capacities. I want to become a professor, and I would love my students to have similar service learning experiences. What attracts me to service learning is that everyone involved benefits: developing communities can utilize technical resources that they could not otherwise afford, while the next generation of engineers can learn about their field and cultures that many would not otherwise experience.

Every year, the MIT Public Service Center helps students like Amos combine their technical skills with rewarding service experiences, through fellowships, programs, and more. Check out web.mit.edu/mitpsc to get involved, then email game-news@mit.edu to get your story told!

Faculty Profile: David Wallace

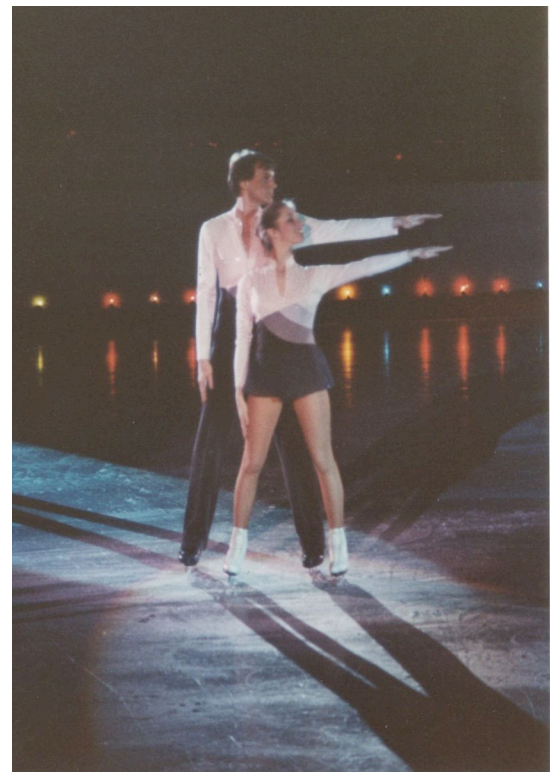
By: Barry Matthew Kudrowitz
GAME Vice President

Associate Professor David Wallace, co-director of the CADLAB, runs the DOME (Distributed Object Modeling Environment) research project. DOME is an enabling technology for a worldwide simulation web. Professor Wallace's training and education include two bachelor's degrees from Carleton University in Ottawa (the first in Industrial Design and the second in Mechanical Engineering) and a PhD under the guidance of Professor Woodie Flowers.

Dr. Wallace's curiosity in physics complements his passion for product design, and this combination has fueled his success in both research and teaching at MIT. And he is very (very) Canadian. He wears shorts in winter (and to fancy banquets) and has a tiny poodle named Keiko. Dr. Wallace's passion in life (aside from gardening, figure skating, woodworking, model ship building, piano tuning, clock tuning, tuning in general, General Electric, General Motors, General Mills, General Ulysses S. Grant, and Colonel Mustard) is product design. David teaches the world-renowned, two-time Emmy/Grammy Nominated 2.009 Product Engineering Processes undergraduate class as well as 2.7something-something, a graduate class. His teaching style is ... well, he wears elaborate frilly handmade figure skating costumes to lab and dances on the tables. He also dresses up like Archimedes and burns Roman ships.

One time, in New York City, Dave's expertise was called upon to defuse a bomb. The would-be assassin had rigged the explosives with a scale. Two gallons of water diffuses the bomb; any more or any less detonates it. There wasn't much time; only 47 seconds left on the ticking clock. And there were no 2-gallon buckets to be found, only a 3- and a 4-. Dave's problem solving instincts kicked in.

Like a primal gallon-measuring animal, he solved the problem, diffused the bomb, and then ate it ... with mustard. Oh, no, wait, that was in Die Hard 3, except for the mustard. I don't know where that came from. Probably from Colonel Mustard. Mmmmmmmm, tasty.



Photos, clockwise from top:

Cartoon of David Wallace and his poodle, Keiko, by the author.

A young David Wallace figure skating for Canada.

Prof. Wallace, as Archimedes, trying to prove the "death ray" myth; for details of the successful test, see: web.mit.edu/2.009/www/lectures/10_ArchimedesResult.html.