



CIS563 - Jello Simulation (Karl Yining Li): Multiple Jello cubes simulated using a mass-spring system imported into Maya and rendered through V-ray. To see the current SIG Center animated demo reel visit <http://cg.cis.upenn.edu/reel>

Letter from Dr. Badler

“Unique” is, well, a unique word: it can’t really be qualified without destroying its meaning. So when students, applicants, and recruiters tell us that CG@Penn is a unique combination of programs offering fundamental theoretical and practical experience with computer graphics, well, we like to believe them. We are not singularly focused on games or on movie effects or on interactive media; in fact our students experience and program all of these. And unique describes our students, with their passions broadly in interactive digital media but with an individuality that CG@Penn encourages and nurtures. A few years ago at a Penn Previews lunch the (astute) sibling of a DMD admit asked me what was special about DMD students. I answered: “They are alike because they are all different.” One need

only look at the scope and breadth of our DMD Senior Projects, our Masters students’ games and effects projects, and our PhD Theses to see that this is true throughout our programs.

In this Newsletter we highlight some of that uniqueness. Enjoy the interview with Brian Silva, one of our CGGT graduates working in visual effects. CG@Penn was active in the Penn “Year of Games” theme and we participated in a number of campus events. The SIG Center hosts visiting scholars, but presently we also enjoy having two PostDocs who we profile here: Funda Durupinar (who was a visitor here before she received her PhD) and Mubbasir Kapadia. Thanks to Joe Kider, Karl Li, and Stewart Hills, we have a significant home-built “rendergarden” up and running in SIG. We had a steady stream of

events, tech talks and recruiter visits. Our students enjoy a wide range of career experiences as they graduate. We bring you up-to-date on this crucial capstone to the CG@Penn experience.

Our students continue to win awards. The summer internship program in 2011 yielded excellent projects and garnered awards for Kaitlin Pollock, Adam Mally and Tiantian Liu. Gaby Moreno Cesar was recognized with a CIS Faculty Appreciation Award. And Kaitlin also received Honorable Mention in the CIS-wide Senior project competition this year! Kaitlin’s project with Joe Kider is highlighted in this issue.

I hope you enjoy this look at the unique enterprise that is CG@Penn as much as we do!

DMD Class of 2016

Yes, it is hard to believe, but we just admitted the class of 2016. This is an amazing class, with a powerhouse of academic and creative talent to offer. The class is unusual in several ways; first of all, of the 18 admitted students, 14 of them are women! Also, for those of you concerned with geography, it is a class with more east coast students than we are used to seeing. We have two students from NJ, seven from NY, two from MA, one from CT, three from CA, one from KY, and then a student from New Zealand and another from South Korea. We’re looking forward to working with all these new DMD students in the years to come!



Introducing Dr. Ladislav Kavan

We are extremely pleased to announce that Dr. Ladislav Kavan will be joining the Computer & Information Science Department faculty in Spring 2013 as an Assistant Professor! Ladislav will be a very welcome new member of the CG@Penn team. Ladislav is currently a Senior Researcher at ETH Zurich, working in the Interactive Geometry Lab with Professor Olga Sorkine. Prior to joining ETH, he was a Research Scientist for Disney Interactive Studios, exploring next generation technology for computer games with Peter-Pike Sloan. Ladislav's recent work has focused on combining data-driven techniques with physically-based simulation, subspace methods, and real-time character animation. His "dual quaternion" skinning technique is used in Autodesk Maya and other 3D digital content creation tools.

Introducing Funda Durupinar

Funda Durupinar is a new postdoctoral researcher at the Center for Human Modeling and Simulation. Funda received her Ph.D. degree in computer science from Bilkent University. She worked as a research and teaching assistant during her Ph.D. study, and taught several courses including Computer Graphics and User Interface Design. Her research interests include crowd simulation with heterogeneous behaviors incorporating psychological aspects of agents.

Funda visited the HMS Lab also in 2008 when she was a graduate student. During her visit, she collaborated with former Ph.D. students Jan Allbeck and Nuria Pelechano; and their work "Creating Crowd Variation with the OCEAN Personality Model" supervised by Norm Badler was presented at the AAMAS'08 Conference in Portugal. They later extended their research to the perception of crowds and published their work in IEEE Computer Graphics and Applications Magazine in 2011. Funda is currently exploring new directions in her research on social crowds.



Introducing Mubbasir Kapadia

Mubbasir completed his undergraduate degree in Computer Engineering at the University of Mumbai, India, in 2007. A passion for computer animation brought him to the sunny shores of California where he received his Masters and PhD in Computer Science at the University of California, Los Angeles, in 2009 and 2011, respectively. Mubbasir tackled several open problems in simulating autonomous human agents as part of his thesis, *Authoring and Animating Virtual Human Simulations*, which has been published as a book.

Mubbasir's research interests include the application of automated planning and machine learning for high-performance visual computing applications, with a focus on simulating functional, purposeful virtual humans that act and interact in complex dynamic virtual worlds while conforming to an over-arching global story.

Mubbasir is just as passionate about games and interactive media. At UCLA, he was driven to establish close ties between the games lab and the graphics lab. He spearheaded several inter-disciplinary projects and presented his work at top venues such as SIGGRAPH. With Professor Eddo Stern, he helped design and teach courses in game design with a hybrid skill set requirement in computer science and design media. Mubbasir also brought his unique perspective to co-teaching CIS 568: Game Design Practicum with Professor Steve Lane here at Penn.

We are delighted to welcome Dr. Mubbasir Kapadia as the assistant director of the Center for Human Modeling and Simulation in the SIG Center for Computer Graphics and wish him all the best in his future endeavors!

Introducing Dr. Benedict Brown

Dr. Brown is a lecturer in Computer Science. In addition to teaching, his research interests focus on 3D scanning and its applications to cultural heritage. His work on non-rigid alignment algorithms has led to the highest quality 3D model presently available of Michelangelo's David statue. He also works extensively on the problem of computer-assisted assembly of ancient wall paintings in collaboration with researchers from University College London, Princeton University, and the University of Leuven, and archaeologists in Thera (modern-day Santorini), Greece and Tongeren, Belgium. Dr. Brown received his Ph.D. in 2008 from Princeton University.



2011-2012 Awards

Kaitlin Pollock

This has been a busy year for Kaitlin Pollock, this year's winner of the Dawn and Welton Becket Digital Media Design Achievement Award. The Dawn and Welton Becket Digital Media Design Award is presented to the DMD senior who exemplifies the ideals of the DMD program through outstanding achievement, citizenship, and mentoring. Kaitlin won an Honorable Mention in the prestigious Computing Research Association's Outstanding Undergraduate Researcher Award national competition for 2012, took first place in the 2011 CIS Summer Undergraduate Research poster contest and was a co-winner of the 2010 and 2011 Diane Chi Summer Research award. Kaitlin was also elected as co-president of the University of Pennsylvania's ACM-SIGGRAPH chapter, was awarded an ACM-W Scholarship to attend SIGGRAPH, and then took Honorable Mention at the conference for a paper she co-authored with Joseph T. Kider, Jr., and Alla Safonova, "A Data-Driven Appearance Model for Human Fatigue." Kaitlin will be starting at Dreamworks Animation in the fall as a Technical Director. Congratulations, Kaitlin, we will miss you!



Kaitlin (left), Adam (second from right), and Tiantian (right) were awarded the Diane Chi Summer Research Award, and Gaby Moreno (second from left) is the winner of the Faculty Appreciation Award. Kaitlin is also the winner of the Welton and Dawn Becket Digital Media Design Award.

Gabriela Moreno Cesar

Gabriela Moreno Cesar has won the Faculty Appreciation Award for 2012 for her contributions to the Women in Computer Science (WICS) organization, her work as a peer advisor, and her superb performance as a student.

In the WICS program, Gaby has been the treasurer, the representative at faculty meetings, the President, and currently the senior advisor. During that time she has developed programs crucial to promoting STEM careers for women, including such things as the WICS TechNights, where she led the development of monthly workshops for high school girls intended to spark interest in computer science. The program has covered such topics as Scratch programming and web development in HTML and PHP.

Gaby helped to create a one-time scholarship for a member of the WICS community to attend the Grace Hopper Conference for Women in Computing. She led the efforts for the WICS High School Day for Girls, where she has served as a panelist and speaker for a daylong event that presented girls with information about the different concentrations and careers that are available within computer science at the University of Pennsylvania. Gaby also created a presentation on

Women in Computer Science and their dream jobs (she collected the data, designed the website and visuals and presented the info), which featured current Penn CIS women and alumnae along with their internship/job offers and past experiences.

WICS duties have also required Gaby to organize technical and recruitment talks by companies such as Google, Microsoft, Facebook, Goldman Sachs, Barclays Capital, and IBM. Such talks are meant to educate women to professional options within the field of CIS. She has also coordinated a yearly field trip to Google headquarters in NYC, and has planned a slew of social events to build the community of women in computer science.

This year Gaby has led the charge to create the WICS Residential Program to create a new living and learning program for women in computer science within the College House System at Penn. The WICS residential program will feature tech workshops, faculty dinners, and industry field trips as well as social coding and a supportive community within the King's Court English College House. She has also contributed to the general welfare of the King's Court house by leading a group of volunteers to renovate the King's Court library, she's led a team to organize dinner discussions that bring attention to faculty in interdisciplinary programs, and helped to plan bi-weekly social events that build the sense of community at King's Court English College House.

In her free time, Gaby has also co-chaired the Society of Women Engineers Leadership Corporate Dinner program for 2 years, where she organized the Engineering School's largest student-run corporate event. She was able to obtain funding from 14 corporate sponsors, capture a keynote speaker, and pull off an impressive event! We all appreciate everything that Gaby does to make Penn, SEAS, CIS and DMD a much better place. Congratulations, Gaby!

Summer 2011 Research Awards

Daniel Garcia, Tiantian Liu, Adam Mally, and Kaitlin Pollock were awarded the Diane Chi Summer Research Award for their work on, respectively, Selecting Agents for Narrative Roles, creating better methods for group-controlled action, reconstructing the ancient city of Pachacamac, and A Data-Driven Appearance Model for Human Fatigue.

Jason Merrin wins Creative Concept Award

Jason Merrin, DMD '13, was awarded the Creative Concept Award in the CWA International Screenwriting Contest for his film, Sleepwalkers.

CGGT Graduates

Cheers for the 2012 graduates of CGGT!

Grace Fong, Kristen Ying, Brandon Bauman, Chun-Fu Chao, Xin Cheng, I-Kao Chiang, Jian Feng, Dan Garcia, Malu Harten, Matt Jones, Eugenia Leong, Gabriel Leung, Han Li, Tiantian Liu, Steve Lovejoy, Brendan Mahoney, Raul Santos Matsui, Fran Menna, Vijay Shingala, and Qing Sun.

These students will be going to many companies around the country, including DreamWorks, Zynga, Merge Interactive, 2K Sport, Color Labs, Havok Games, Blackrock, Pixar, Microsoft, Blue Sky Animation, Electronic Arts, Launch, and Storm8. We also have one graduate who will be pursuing a PhD degree at Penn.

Alumni Profile: Brian Silva

Brian Silva graduated with a Master's degree in Computer Graphics and Game Technology (CGGT) in 2006. Since then, he has been working in the visual effects industry, from Disney Animation to Double Negative, wearing many hats along the way that straddle both the technical and artistic side. He is currently working as a senior technical director at Sony Imageworks in Los Angeles, on Men In Black III. We are delighted to have with us Brian Silva – a CGGT graduate and visual effects industry veteran – our very own super hero.

Every super hero has an 'origin' story. What is yours?

I'm from the San Francisco Bay Area. I grew up within a 30 minute drive of both Pixar and ILM (Industrial Light & Magic), which were huge inspirations as a kid. My father is an engineer, and my mother, a musician, so I've always been around that mixture of art and science.

What was your experience at Penn like?

I came to Penn as a Masters student in the Computer Graphics and Game Technology program. The program was still in its early stages; we were the second graduating class. The relatively small student body was a great benefit because it gave the students plenty of one-on-one time with Dr. Lane, the program director. The classes I took as part of my degree included Dr. Badler's computer graphics class, the computer animation and game design classes taught by Dr. Lane, modeling and animation classes in the design school, and the engineering entrepreneurship class. One class that I remember well is the seminar with Dr. Lane where we read, presented, and implemented SIGGRAPH papers.

I didn't get too deeply involved in research, as the CGGT program was so hands-on. We were constantly working on projects; from art projects in the design school, to play-testing games in the game design class, to polishing the ray tracer for computer graphics.

Tell us about your experience in the visual effects industry.

Since Penn, I've been a few places. I started out at Walt Disney Feature Animation and was there for about 3.5 years. I got the opportunity to work in a variety of roles, ranging from software engineer, pipeline engineer, to technical director. I was lucky to work on several interesting topics including pipeline software programming, artist technical support, artist tool programming, shader writing, render wrangling, stereo rendering and compositing, and FX tool creation. The film projects I worked on included Bolt, Prep & Landing, Beauty and the Beast 3D, and Tangled. Some of my work on Prep & Landing was presented at a SIGGRAPH sketch in 2010: <http://bit.ly/setmAndForgetm> [PDF].

My aspiration to be an artist led me to Double Negative VFX. I started out as a lighting artist, working on environment and creature lighting. I also did FX animation, matte painting, modeling, lookdev rigging, and shot layout. For one project, I built a pipeline for generating and art directing massive multi-level procedurally generated cities. I also worked on Inception, Harry Potter and the Deathly Hallows Part I, and Part II.

Currently, I'm working at Sony Imageworks in LA on Men In Black III as a Senior Technical Director.

How did your education at Penn help you in your workplace?

It helped lay a strong foundation for an in-depth understanding of computer graphics, along with the invaluable experience of numerous hands-on projects that have been a huge boon at every stage of my career. When I first started as a software engineer and pipeline engineer, my CGGT education helped me understand what the data was that I was passing around. I could debug things quickly because I had a fundamental understanding of how geometry was stored and manipulated and how it was rendered.

When I became an artist at Double Negative, it was a huge benefit to have a strong grasp of fundamental concepts. I could solve my own technical problems rapidly and make quick and informed decisions on how to get a certain look to a shot because I understood the rendering algorithm at its basic level. I didn't need to research all the different options in the in-house fluid simulator because they were pulled directly from many of the SIGGRAPH papers we had studied at Penn. When I worked on the FX tools for Prep & Landing I was dealing with curves and splines and directly used things I had learned in Dr. Lane's Animation class.

At Sony, we are using Arnold, a path-tracing renderer. Path-tracing is becoming the trend in the visual effects rendering world, so that ray-tracing project in Dr. Badler's CG class was invaluable experience to have under my belt, both for getting the desired look and optimizing render times.

The CGGT program is obviously a fantastic program for folks that want to be R&D engineers, researchers, and get into more technical positions in the CG industry. But in my career so far, I've also found it's made me very valuable as an artist. Every company I've talked has liked the artistic work on my reel, but they've really liked the fact that that I have the technical background to supplement my artistic skills.

This double knowledge has allowed me to be more productive, to swing widely into different disciplines across the pipeline to get a lot of experience and handle broader tasks, and to pick up interesting and rewarding artistic challenges because the art is always pushing the technology in this industry. Without a doubt, the CGGT program has helped lay out a strong foundation for my career.

How is it like in your current position? Describe your day-to-day responsibilities.

My main responsibilities at Sony right now are as a lighting TD, working for Men In Black III. My primary responsibilities include setting up light rigs, rendering assets, and developing the overall look and lighting for the shots in the film.

Most days consist of making lighting and shading changes to address notes from the VFX supervisors, and experimenting with different effects. The general workflow of a lighter is to finish an artistic setup, do rigorous test-rendering, and then farm off lots of frames for overnight rendering.



An interesting, and somewhat unexpected, part of my job entails optimizing my time at the studio, in order to make the best possible use of the off-hours in the evenings and weekends to let the computers do their work. Learning how to organize things so that everything is in order for launching jobs is crucial – one mis-tweaked setting can ruin an entire night's render.

Due to my technical background, I have several shots that require some technical development to come up with the best solution to a problem, using in-house and 3rd party software. Sometimes this is simply optimizing a render that includes a massive amount of data, sometimes it's a more unique problem, such as figuring out how to use the filmed plate of an actor in conjunction with CG geometry so we can twist, mangle, and create a crazy effect while retaining subtleties of the actor's performance.

One of the most fascinating things about this industry – despite the fact that there are lots of solid techniques available today, with well-known solutions to many CG problems, and some very powerful tools at our disposal – every film I've worked on has presented unique challenges that require people to analyze, get creative, and try crazy things to get the desired result.

What are your future goals?

My immediate future goal is to continue to expand and improve my artistic skills. I especially feel the need to get a much deeper understanding of photography and the visual aspects of live-action compositing. I will also expand my knowledge of other departments so I can get a better perspective on show-wide problems and help solve them better. My eventual goal is to become a CG or VFX supervisor.

I would also love to get more people into this industry to do what they love to do. In addition to deep CG programs like DMD and CGGT, there are many good professional training schools available today. However, I still encounter people who have the passion, but don't quite know what to do, how to do it, or just don't think they can.

I think this is one of the most rewarding industries on Earth. It's a true collaborative field between art, science, technology, and humanities. It has an ever-evolving technological cutting-edge and a hugely vibrant community evident in SIGGRAPH. Millions of people are reached year-round through wide-scale distribution of its products such as films and games. It has the potential to truly accomplish a huge variety of things, and a unique feel of camaraderie between the people in it. I want this field to succeed, to continue to grow, and to continue to do what it does with passion and enthusiasm. My future goal would be to help that momentum along.

Year of Games @ Penn

Each year, the University of Pennsylvania sponsors a series of events centering around a theme chosen by faculty, staff, and students. The 2011-2012 academic year was devoted to an exploration of games in all forms. The Year of Games @ Penn kick-started with Jane McGonigal's *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*, to serve as the text for the Penn Reading Project. Dr. McGonigal, in her stimulating lecture to the freshman class, emphasized the major role that games play in our lives. She unequivocally stated that virtual realities have the power to make us happy and provide exhilarating rewards, which can be harnessed to improve our daily lives.

The Trescher Entrance atrium of the Penn Museum featured a two-case display in the spirit of games. The Games of Chance case included 3,300-year-old knucklebones from Israel, which served as ancient dice for predicting the future. A variety of Native American playing balls, and a bamboo ball which was used to play sepak takraw, Thailand's official sport, were included in the Games of Skill case.

RecycleMania was a 2 month competition involving more than 600 colleges and universities across the United States and Canada. Campuses competed in a variety of contests geared towards achieving the highest recycling rate and collecting the largest amount of recyclables. Penn recycled approximately 29 percent of its waste over the eight-week competition, placing second amongst its Ivy League peers in the Grand Champion category. Penn also topped its Ivy League rivals in Waste Minimization, generating only 58 pounds of trash per person over the duration of the competition.

Penn faculty, students, and alumni were not to be left behind. The School of Nursing Game Solutions for Healthcare project offered opportunities to formulate healthcare solutions using game technology, with the overarching goal to further stimulate the inter-connectivity between healthcare science, research and practice cultures. Example applications included medication management tools, health risk detectors, and applications that improve patient-centered care. DMD senior Nicholas Reynolds and DMD alumnus Warren Longmire served as technical advisors to the nursing student teams.

The team led by Professor James Corner from the School of Design was chosen from more than 100 teams worldwide, to design several public spaces that will be part of London Olympic Park South. This project will be part of an urban transformation project, aimed at using the Olympic space in the years after the games as a place to draw in both locals and tourists.

Penn hosted the first LEGO League, which had middle school students competing to design the best projects based on the theme of food. The competition involved a research and game portion, with winners traveling to the Food Factor World Festival in St. Louis to join teams from around the world.

Gamification – the application of online game design techniques in non-game settings – has captured the attention of leaders in business, education, policy and even anti-terrorist communities. In light of this growing trend, the Wharton Business School held a conference titled, *For the Win: Serious Gamification*, with participants discussing its use in business, government, and other arenas. Professor Kevin Werbach taught a class which examined how game techniques can be applied in a business context, as well as how new business models can be attached to traditional game play mechanics. Our CGGT students attended the final presentations of this class to inspire future collaboration opportunities.

Students in the DMD and CGGT programs used the theme of games to create and innovate. Tiantian Liu, our newest PhD student, harnessed the use of computer vision algorithms to create a crowd participation game. The growing use of the Kinect sensor inspired DMD students to create natural user interfaces for interactive applications such as authoring crowd behaviors. Benjamin Sunshine Hill's thesis work on the perceptual level of detail of autonomous agents was very well received in the games industry, with articles published at GDC and AIGAMEDEV. Alexander Shoulson created ADAPT: an open source framework for developing autonomous agents, for use in narrative driven games. These were just some of the many exciting projects that were conceived and developed within the SIG Center of Computer Graphics at University of Pennsylvania.

The Academic Year in Visitors

<http://cg.cis.upenn.edu/events.html>

July 18: Benedict Brown, a post-doctoral fellow at the Katholieke Universiteit Leuven, gave a lecture on reconstructing ancient frescoes with the aid of computers. (See introductions on page 2.)

In September: Google tech talk, Twilio information session, Google WICS event, Microsoft recruitment talk, SEAS career day, first meeting of the Penn SIGGRAPH chapter, PennApps Hackathon, Zynga information session, Lucas Arts tech talk, Pixar tech talk and interviews.

September 13: Nancy Pollard from the Robotics Institute and the Computer Science Department in Carnegie Mellon University gave a talk on directing physically based (and physical) interactions.

September 16: Students who did research at Penn, including those who worked in the SIG lab, presented the results of their work in Levine Hall. Among the visitors were four faculty members who acted as judges and gave awards to the posters they deemed to be the top three. Third place went to Casey Davis, second place went to Yonas Solomon, and first place went to DMD-er Kaitlin Pollock.

In October: Demo reel night & DMD Senior Project Alpha reviews.

In November: Microsoft Games Recruiting talk and interviews and Sony Imageworks recruiting talk and interviews.

November 22: CIS Distinguished Lecture & Colloquia Speaker, Eitan Grinspun from Columbia University gave a talk on mathematical and computational models of physical simulations and their application in film, consumer products, physics, and medicine.

December 6: CIS Colloquium speaker Ladislav speaker, Ladislav Kavan from ETH Zurich gave a talk on skinning and clothing for 3D virtual characters. (See introductions on page 2.)

January 19: Computer Graphics Colloquium speaker, Hao Li who is a post-doctoral researcher working with Professor Eitan Grinspun (Columbia) and Professor Szymon Rusinkiewicz (Princeton) gave a talk on tracking deformable surfaces.

February 3: Aaron Hertzmann from University of Toronto was jointly invited by GRASP and HMS Labs to give a talk on Feature-Based Locomotion Controllers for Physically-Simulated Characters.



At Poster Day on September 16. Pictured from left to right: Shutong Yu, Adam Mally, Matt Jones, Tiantian Liu, Marley Gilb, Casey Davis, and Yonas Solomon



An image of the SIG Center's newly created RenderGarden. Karl, Stewart, and Joe "recycled" 35 Render Nodes (135 computer cores) from the engineering school. The farm currently has Renderman and Open Grid Scheduler installed.

DMD Seniors & Plans for Undergraduates

It has been a busy year for the DMD seniors, all of whom have full time jobs secured. Justin Broglie will be building his new company, Relative Commotion, a design company specializing in web, print, identity, and film consulting. The company aims to design "a better world by working with socially and environmentally conscious clients and supporting innovative initiatives." Joe Forzano will be going to NYC to work for BlackStone Group, as will Sasha Verma, while Ryan Gormley will be joining Microsoft. Eliot Kaplan has been named Director of technology at the Westminster School in Atlanta, and will be teaching STEM curricula to high school students. Kaitlin Pollock will be going to DreamWorks Animation in Los Angeles, and David Yang will be going to VMWare. Peter Kutz will be interning at Pixar and returning to Penn in the fall, and Alice Yang will be going to Electronic Arts, and Nick Reynolds will be going to Zynga. Marley Gilb has joined Blue Sky Animation, and Kaitlyn Reese is at Gemini Systems in New York City.

The DMD juniors are also busy at internships across the country. Jason Merrin will be working in the story department of Microsoft Games, while Karl Li will be working at DreamWorks animation, along with Nop Jiarathanakul. Both Nop and Karl will return to Penn in the fall and have sub-matriculated into the CGGT masters program. Fannie Liu and Jiali Sheng will return to Google, and will be joined by sophomore Elissa Wolf. Yui Suveepattananont has won a DREU Research Fellowship and will be working with Dr. Ming Lin at UNC Chapel Hill. Dan Knowlton will be interning with LucasArts, while Gaby Moreno-Cesar will intern at VMWare, and the Ian Lilley will be going to AGI, while brother Sean works at AMD. Mansha Mahtani will be interning for Ernst and Young and Michael Rivera will be interning for LinkedIn. Christine Uyemura will intern at Lucas Arts and Mike Walczyk will intern at Zoic Studios. Liliana Matos is doing design and UI for a start-up based in Philly.

Sophomore Samantha Merritt has also won a DRUE Research Fellowship and will spend her summer at U of MN! Tara Siegel will be working at NBC's 30 Rockefeller Plaza office, while Eric Lee will be taking an internship at the Institute for Creative Technologies at USC. Judy Trinh, Jeremy Newlin, Lucy Xiao, Corey Novich and Zia Zhu will work on research in the SIG Lab. Dave Sharples will be working in CA for DJ Tech Tools, while Kevin Shen does an internship at the Washington Post graphics dept. Freshmen will also be busy, with Theodora Pajaczkowska, Brian McNeely and sophomore Jeremy Newlin will join Mark Van Langeveld as Residential Teaching Assistants for our summer graphics SAAST program, and Joseph Tong is joining Eliot Kaplan in the SAAST program for computer science. Colin Feo will be working for game company in Austin, and Joseph Tong and Max Gilbert are doing internships with DMD alum nus Neil Halloran in film.

CIS 106: Visualizing the Past

Interdisciplinary academic endeavors are materializing across Penn's campus, and computer graphics has also risen to the challenge of Integrating Knowledge – one fundamental tenet of The Penn Compact as envisioned by President Amy Gutmann.

Aside from majoring in an interdisciplinary course of study in the Computer and Information Science Department, students can also take standalone courses that bridge traditional academic boundaries.

This past fall, Professor and SIG Lab Director Norm Badler taught CIS 106, "Visualizing the Past", with Anthropology

Professor Clark Erickson. CIS106 is a highly interdisciplinary course that approaches research level issues from both inside each field as well as from outside using the perspective and context of the other. For example, anthropology of ancient cultures is viewed through a computer science lens of "how can we transform known information into models and plausible visualizations of that culture and its people." Conversely, computer science is viewed not through programming skills, but through the understanding and utilization of "computer models to recreate and visualize architecture and cultural artifacts." This third iteration of the course encouraged students to consider how to visually represent Pachacamac, an archeological site in Peru, as well as its generations of inhabitants in a contemporary museum exhibit – especially by using computer graphics and animation – while also considering problems that face anthropologists today.

The scope of the students' creations not only reflects the rich culture at Pachacamac, but also the physical impact of history upon that site. Students studied structures that remain on the site today and used Autodesk Maya software to envision how they may have looked prior to years of abandonment and natural decay. Water sources and their impacts were analyzed using ArcGIS. Students virtually recreated the beer brewing process and used motion capture techniques to animate rituals. Clothing of both men and women in several levels of the social hierarchy were modeled using Marvelous Designer software. As is evidenced by this partial list, numerous impressive projects resulted from the opportunity to approach problems from an interdisciplinary perspective.

Professors Badler and Erickson hope to teach "Visualizing the Past" again in the future. In addition, a proposal has been submitted for an exhibit at the Museum of Archeology and Anthropology at Penn which will take Pachacamac as its subject.



Multi-Modal Motion Capture Techniques for Character Animation

The Synchronous Multi-Sensor Motion Capture Lab is a cutting edge approach to capture human motion. Previous data-driven motion capture methods provide only one channel to collect data and animate characters. Although these methods hold promise for creating animations, they fail to capture the many subtle complexities such as panting, sweating, flushing, and eye movement. We have built a Synchronous Multi-Sensor Capture facility to acquire a range of information including; motion capture data, biometric signals, force data, sole pressure readings, eye tracking movement, finger movements, high speed video, and sound.

Our first major project used this synchronized data to "exhaust" virtual humans. Humans display certain visual cues and they tire during physical activity. After a set of squats, jumping jacks or walking up a flight of stairs, individuals start to pant, sweat, lose their balance, and they flush. Simulating these physiological changes due to exertion and exhaustion on an animated character greatly enhances the character's realism. These fatigue factors depend on the mechanical, physical, and biochemical function states of the human body. The difficulty of simulating fatigue for character animation is due in part to the complex anatomy of the human body. Our capturing technique acquired synchronized biometric signals and motion capture data to enhance character animation. Our approach utilizes an anatomically derived model of the human body that includes a torso, organs, face, and a rigged body. This model is then driven by our biosignal output. Our animations show the wide range of exhaustion behaviors synthesized from real biological data output. We demonstrate our method by augmenting standard motion capture with exhaustion effects to produce more realistic appearance changes during three exercise examples. We compare our technique with both simple procedural methods and a dense marker set data capture of exercise motions.

We plan to release a large public database over the summer which will be a free-open source asset for researchers and developers. This will include samples from all our modes of capture.



A sample character from the Data-driven model for human fatigue, rendered with the SIG Center Renderfarm.



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