TEACHING STATEMENT

Chenfanfu Jiang, August 2019

It is my strong pursuit to influence the world not only as an active researcher advancing science and technology, but also as a dedicated educator who transfuses knowledge, discipline, and experiences to others. In addition, I do not view the act of teaching as a unidirectional data flow, since I gain substantially deeper understanding of the materials I share, and I am rewarded great satisfaction in feeling to help develop individuals' potential and career. As an Assistant Professor I not only have the chance of conducting exciting educational offerings in the university, but also am fortunate to mentor a number of talented individuals across undergraduate and graduate levels. The rest of the document details my view, experience, and plan on teaching.

1 Classroom teaching philosophy

I believe that interest is the best teacher. Being genuinely interested in the topic is the ultimate motivation for students, or anyone, to spend time thinking, searching, trying, which eventually leads to a solid understanding of the material and mastering of the skills. Therefore, I believe that the number one task of a course instructor is to "get the ball rolling". Luckily enough, the research demos of the computer graphics field are generally interesting and sometimes exciting to watch for most undergraduate and graduate students who are new to the field. I have been leveraging this advantage to arouse student interest by showing demos of the latest research accomplishments at the beginning of lectures, and showing demos of related work before diving into the technical details.

Sustained interest in a topic relies on a good understanding of the course materials, both conceptually and technically. Beautiful graphics demos are often backed by difficult mathematical formulas and complex algorithmic techniques. When the course material delves deeper and becomes more complex, some students tend to become frustrated and begin to lose interest if they have a weak technical understanding of the material. This is actually a very common phenomenon in the learning process of any science or engineering topic. To resolve this difficulty: (1) For the more mathematical content, I spend sufficient time on explaining high-level concepts and help the students form intuitions and reason about the formulas and procedures, as opposed to simply applying theorems, deriving formulas, etc. (2) For the more engineering content, I believe that examples and hands-on experience are especially helpful to build up in-depth and long-lasting comprehension of the materials. It also helps build up tangible connections between the knowledge taught in the classroom and real-world applications. Hence, I construct a substantial number of high-quality assignments and programming projects for the students. High-quality projects with exciting results on one hand help the students master the algorithms while on the other hand it is highly rewarding to implement a practical industrial software solution.

I always value the spirit of discovery and creativity. Therefore, in addition to creating high-quality assignments for the students, I also encourage the students to come up with their own project topics. I help them assess the technical feasibility of their proposed ideas and provide them with further technical advice that may even be beyond the scope of the course.

Considering the diversity in the technical backgrounds of the students as well as their different levels of interest, I also often give basic assignments and extra assignments. Only the basic assignments will be mandatory for the course, whereas the extra assignments will be optional and designed for those with more solid backgrounds, higher interest, or those who are planning a career in computer graphics and/or scientific computing.

Experience During my multiple offerings of the graduate course *CIS 563: Physically Based Animation*, I have found that the students are extremely motivated to stay focused on the lectures, since the course projects on animations and visual effects provide a valuable opportunity for them to improve their demo reels (which is highly helpful for job searching in the computer graphics and gaming

industry). Interestingly, this course probably contains the most difficult mathematical concepts and derivations among all computer graphics courses available at Penn. Following the methodology discussed above, I think I am very close to reaching a sweet spot in mixing mathematical foundations and implementation details into rewarding outcomes and creative innovations.

Unlike CIS 563 in which almost all students are already strongly interested in computer graphics (thus highly motivated to learn math), my undergraduate course *EAS 205: Applications of Scientific Computation* had a drastically more versatile set of early-stage undergraduate students from various departments in the engineering school. After one semester of teaching it (with a focus on many linear algebra concepts), I observed a discrepancy in the students' feedback where feelings in both extrema generally exist. I will take four actions in the next offering: (1) I will engage Penn's Center for Teaching and Learning (CTL) in the design of the course contents and lecture materials; see "Curriculum Development" section below. (2) Working with all my Ph.D. students as highly qualified TAs, I will design a set of new projects that more tightly reflect the mathematical theories. (3) I will also transform some of the lectures into lab sessions to encourage students to do active learning and work as a team. (4) When explaining mathematical concepts, I will switch from using slides to blackboard style with frequent questions and discussions (as I have been doing in CIS 563), which I believe is a much more engaging process than going through technical contents on slides. I am confident that these actions will bring a brand new and enjoyable experience to EAS 205.

2 Mentoring

I strongly feel it is my responsibility to devote energy to mentoring students and trainees for their career development as a role model. At the University of Pennsylvania, I have been a mentor and research supervisor to 2 postdocs, 4 PhD students, 3 Masters students, 20 undergraduate students, and 5 visiting scholars.

- My postdoc Andre Pradhana (2017-2018) joined Dreamworks Animation as an RnD engineer at Dreamworks after co-authoring 4 SIGGRAPH/SIGGRAPH Asia papers with me.
- My postdoc Ming Gao (2018-2019) joined Tencent America as a research scientist after co-authoring 7 SIGGRAPH/SIGGRAPH Asia papers with me.
- My first PhD student Joshuah Wolper (jointly advised with Professer Norm Badler), who started in Fall 2017, has published an I3D(PACM) paper and a first-author SIGGRAPH 2019 paper. He is also co-authoring on a journal article to be submitted to Nature Communications. He has made consistent and satisfactory progress towards his PhD dissertation, and finished all of the preliminary exams.
- My PhD student Minchen Li was admitted in Fall 2018 after getting his Masters degree at UBC. In his first year he published 3 SIGGRAPH papers with me (one being first author). He is also the first author of a submission-ready Transaction on Graphics (TOG) article.
- My PhD student Yu Fang was admitted in Fall 2018. He has published 3 SIGGRAPH papers (one being first author) and 1 SCA paper (as first author) with me.
- More recently I recruited Ziyin Qu into our PhD program (starting Fall 2019). Ziyin was a Penn Scientific Computing Masters student and has been working with me since 2017. He has published 2 SIGGRAPH papers (one being first author).
- My Masters student Bowen Yang was in the Computer Graphics and Game Technology (CGGT) Program. He published an I3D (PACM) paper as first author, and has recently joined Apple.
- My visiting scholar Xinlei Wang (from Zhejiang University), who started working with me since Spring 2018, has published a first-author SIGGRAPH Asia paper with me. He is also the first author of a submission-ready Transaction on Graphics (TOG) article.

- My visiting scholar Yupeng Jiang (from University of Sydney), who visited me from Fall 2018 to Spring 2019, has succesfully acquired extensive research training on MPM in my group, and is the first author of an upcoming submission to International Journal for Numerical Methods in Engineering (IJNME).

- My Summer 2019 undergraduate students Nicholas Magarino, Saranya Sampath, Thy Tran, Enoch Solano, Sang Lee and Shenqi Hu won the third place of the CIS 2019 Summer Undergraduate Research for their work *E.A.T.S. Extraction of Abdominal Topology and Simulation*.

- My Summer 2018 undergraduate student Yi Gu won the first place of the CIS 2018 Summer Undergraduate Research for her work *Robotics Control with Physics-based Fluid Simulation in Virtual Environment*.

- My summer 2018 undergraduate student Jacob Snipes won the second place of the CIS 2018 Summer Undergraduate Research for his work *H.O.G.W.A.R.T.S (Handy Offline Grid-based Wind Advection Reverse Time Solver)*.

- My summer 2018 undergraduate students Liangzhen Fei and Chen Li won the third place of the CIS 2018 Summer Undergraduate Research for their work *Frame Interpolation of Smoke Simulation with Neural Network*.

- My summer 2017 undergraduate students Yuanming Hu, Yu Fang, Ziheng Ge, Ziyin Qu won the honorable mention of the CIS 2017 Summer Undergraduate Research for their work *Enriching and accelerating the Material Point Method*.

I am continuing to expand my research group to mentor more talented students and scholars.

I enjoy being a research mentor and project leader, and I believe that such a role is essential not only in building an outstanding research group, but also in setting the example in professionalism for the students. I worked closely with my mentees in all stages of the research process: idea brainstorming, related work researching, mathematical derivations, coding for simulations/experiments, technical paper writing, etc. I shared my research experience with my mentees, and provided them with career advice, taking into account their own backgrounds and goals. I have also learned to tailor my mentoring style to bring out the best in students according to each student's unique personality and working style.

In various graduate and undergraduate research projects I supervised, in addition to working closely with each of my students, I also encourage them to work in pairs or groups. In this way, the students are able to learn from each other, and they are usually more efficient in problem solving, since having two minds actively working on the same problem provides frequent opportunities for brainstorming, and the extra set of eyes helps catch errors early. Working in a group also help the students develop the habit and skills of teamwork, which I believe will be very important and beneficial to their future success. I especially encourage a mix of senior and junior students working together, because in this way the junior students can quickly learn the required research/technical skills from the senior students; meanwhile, the senior students have the opportunity to develop leadership and mentoring skills that will help them in their future careers as well.

3 Curriculum development

Undergraduate level. I am re-designing the undergraduate *EAS 205: Applications of Scientific Computation*. As an introductory scientific computing course, it currently covers basic linear algebra and MATLAB programming assignments. This course contains enrollment from a diverse range of students from many majors across the engineering school. To modernize the course, I am reconstructing its syllabus to emphasize topics that are algorithmic- and computation-related, and to cover modern techniques in scientific modeling, visualization, floating point systems, numerical optimization, etc.

with additional focuses on modern C++ standards and CPU/GPU parallelization features. I attempt to expose undergraduate students with specific practices on computational tasks in real industrial, biomechanical, and visual computing tasks. In the meanwhile I have been consulting with Penn's Center for Teaching and Learning (CTL) on the syllabus and how to infuse additional active learning techniques in the classroom, as well as best approaches in incorporating my new research into the teaching. The overall guideline of my new instruction style for the course is to find the perfect balance between concepts, details, and implementation, for advancing cross-disciplinary education in computational science.

Graduate level. Throughout its multiple offerings, my graduate course *CIS 563: Physically Based Animation* keeps absorbing state-of-the-art innovative algorithms in research frontiers into its syllabus. Currently at its third offering, the course topics span algorithms for simulating solid and fluid dynamics. I have been and will be integrating advanced tools and algorithms into the course allowing students to explore wider ranges of new applications. In this course I have also been promoting mixed-disciplinary topics such as structural mechanics, and will establish an improved syllabus oriented towards mathematical and computational foundations for accommodating a broader range of engineering graduate students for their learning and research. I will also construct a new graduate seminar course series (*CIS 700* series) to expose students to the state-of-the-art in computational science advancements. This seminar offering will feature invited guest lectures and investigations into the latest research directions.

Educational workshop organization. I have, in the past, and will continue to play in the future, a leadership role in educational activities of the Penn Institute for Computational Science (PICS), a multidisciplinary institute which coordinates and conducts software architecture workshops and coding boot camps. Currently I am the Workshop Chair and lead the design of the workshops. I was also the Conference Chair for the 2018 Annual PICS Symposium. Dr. Ravi Radhakrishnan, director of PICS, has been collaborating with me to facilitate PICS educational and outreach activities which impact the laboratories of 85 faculty, over 300 scholars at Penn, and scholars at neighboring institutions like Drexel, Temple, and U. Delaware.

Research community. As a strong proponent of sharing educational materials, I strive for releasing polished course materials to the public domain and ensuring all electronic data can be reused by other institutions as free as possible of restrictions. I have also been a strong proponent of sharing knowledge with a broad community through tutorial sessions organized in conferences. In 2016, I organized an MPM course at the annual ACM SIGGRAPH conference. Detailed course materials are posted and maintained at a public website. In 2019, I offered another SIGGRAPH course on High-Performance Computing for hybrid Lagrangian/Eulerian methods. It is anticipated that my work in the next few years will result in increasingly more valuable technical materials that can be shared with the community, and I am devoted to continuing to attend, publish, and organize tutorial sessions, both in SIGGRAPH and at other major conferences in fields such as computational physics, robotics, and healthcare.

4 Broader participation

I have a history of engaging under-represented minorities and female students in computing research, including hosting various student groups for presentations on computer graphics at the SIG Center for Computer Graphics and the Youth Outreach Adolescent Awareness Program (YO-ACAP) camp. I have a leadership role in the Digital Media Design (DMD) undergraduate program (majority 70% female). Working with campus cultural clubs and services, my lab provides undergraduate research positions and commits to a 65% recruitment of underrepresented minority and women students. I have and will continue to leverage programs including Penns Undergraduate Research Mentoring (PURM) programs, Center for Undergraduate Research and Fellowships (CURF), the Rachleff

Scholars, CIS Undergraduate Research Program for women and underrepresented minority students, and REUs to recruit and support undergraduate researchers.

I believe that computer graphics has the distinct ability, through appealing visual results and the technology behind it, to encourage high school students to pursue computer science and engineering majors in college. I annually demonstrate elements of the DMD program through a SIG Lab tour for the high school girls who attend WICS High School Day for Girls. This program continues to be extremely popular among high school girls, guidance counselors, and teachers.

Working with Science Outreach Initiative, I have established collaboration with the Franklin Institute (TFI) to participate in a Portal to the Public (PoP) training on communicating with the public and developing a table top research demonstration. I will attend the event myself and provide funds to send graduate students over the course of the grant. This activity also contributes to a unique graduate student training experience during their help in developing and facilitating the activities. I also plan to participate in the annual Penn Summer Prep Program, a two week program where students select two modules to take while living on campus. Classes are taught by both my graduate students (for training) and myself.