A Conversation with the CHCCS 2016 Achievement Award Winner

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Abstract

This paper constitutes the invited publication that CHCCS extends to the achievement award winner. This year, we experiment with a new interview format, which permits a casual discussion of the research area, insights, and contributions of the award winner. What follows is an edited version of a conversation that took place on April 7, 2016, via Google Hangouts.

The Interview

Paul: Hello Michiel, and congratulations on being recognized as the 2016 CHCCS achievement award winner!

Michiel: Thanks, it is an honour! Much of the credit should really go to the students and collaborators that I've worked with over the years.

Paul: It is interesting to know how people end up doing what they are doing. I'm wondering how you first became interested in computer graphics and animation?

Michiel: I first began playing with graphics on our Radio Shack TRS80 Model I, which had all of 48 kb of memory and you could plot points using these rather giant pixels with a 128×48 resolution. But it was enough to experiment with some very primitive 3D wireframe rendering of my own concoction. Then a bit later we got a mini colour plotter, which was a giant step forward given its resolution, and really forced you to think about hidden-line removal.

Paul: So that would be early 80s?

Michiel: Yes, it came out in 77, and we probably got it in 78 or 79, when I was in junior-high.

Paul: With computer graphics and animation now being a mature field, what would you say has changed the most since you first started?

Michiel: Incredible changes in compute hardware. Transitioning from heuristics to principled scalable approaches, and the use of physics. When physics was first used to model cloth, paper, tearing, like the early Terzopoulos papers [14, 13], I remember thinking this is fantastic but it won't be practical in any way for a long time to come, given how expensive it was to compute. But with faster hardware and better algorithms it is amazing to see how far things have come – we've gone from pie-in-the-sky to physics-based sims that run in real time on a phone! These early papers and my interest in sports were why I got started on using physics and control for modeling human motion. I was also interested in robotics early on.

Paul: Which sports?

Michiel: I'm a great fan of skiing and road cycling, among others. In my undergrad computer graphics course, my project was a procedurally-animated model of a skier doing a back flip off a jump. Early in my M.Sc. work, I remember being inspired by the work of Yeadon, who had developed simulations of twisting somersaults in the context of biomechanics [20]. I found it fascinating that you could do simulations of these kinds of things. It also became obvious to me just how much becoming skilled at a sport was very much about learning good solutions to some pretty hard control problems, and the controls courses that I took in engineering did not provide good answers as to how this might work.

Paul: I note that your most cited paper is on composable controllers [3], and the theme continues to have traction with you and many others in the field. But SIMBICON [22] comes in as a close second, and is seen by many as the paper that rebooted the physics based animation community and broke the general addiction to motion capture.

Michiel: Yes, there have certainly been a number of ups and downs over the years for physics-based character animation. Certainly there was a major pause after the initial excitement of space time constraints [19], Raibert and Hodgin's work on legged locomotion [11], our work on state-space controllers [17], and a batch of papers on derivative-free methods for optimizing control [16, 10, 12]. Then there was a span of many years where not much appeared, in part because of the success of data-driven methods. Because so much could be done with mocap it took a long time to come back to trying to solve this problem from first principles. The SIMBICON paper was really a few useful tweaks to earlier foot-placement rules for balance, but it showed that robust walking could in fact be quite simple and that physics based models could be quite expressive. In many ways the computer graphics community has been generous with work on physics based character animation, given that its potential was always in the long term. So it was a question of continuing to encourage and accept papers in the area, even though it was clear that more work was needed before these methods would be adopted.

Paul: Yeah, long term potential, but companies have taken a shot at it. The Natural Motion software seemed so good, but somehow not a complete success?

Michiel: They made a valiant effort. I don't know too much about how the tech works internally because they were reluctant to share what they did with the community, but I'm sure they were looking at the papers that were appearing. You can have the right idea, but the wrong timing, so in many ways timing can be everything. So they were in many ways a bit early. I think the work flow you need to use to make effective use of physics based characters will at least be somewhat different from the work flow used to work with mocap data, so that has been an obstacle. As well, the complexity of the tools. The early Natural Motion work was complex enough that I believe that Natural Motion engineers would work with companies to incorporate it into a game. But they had the right idea, to start with rag dolls and then move to smart falls. That's where the work with Petros, who pushed the work in the direction of a digital stunt man [4], has been a sweet spot for early adoption of these ideas. And, whenever you do any kind of demonstration of work in this area, people want to see the characters fall. It shows that the physics is running and is always entertaining.

Paul: Yes, it certainly makes me think of the reactions to your work with Thomas Geijtenbeek [5]. In the end how many hits did you get

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on the video? People love seeing characters fail, and they always laugh.

Michiel: Yes, Thomas had a fantastic system for optimizing muscle-driven motions, and he did a great job of putting together the video showing the learning progressions. But we were a bit disappointed with the lack of reaction from the community for what we thought was really exciting work. And then suddenly, the video hit the front page of reddit[1], and then, within a week, it had a million views on Vimeo[2]. Many other researchers contacted us only after learning about the work through their social media channels. The lesson I take from this is that social media is becoming important for research, as is providing videos or talks that explain the core ideas and results of a paper. I know for myself, I'll often watch a talk video first before reading a paper, particularly if it is in an area where I'm not as familiar with the work — the talk will often more directly discuss the key ideas without the surrounding formalism, and will more frankly discuss the limitations than what you will often see in the paper.

Paul: To come back to the companies and commercialization, I'd love to hear more about Motion Playground, because it was awesome, but perhaps also a timing problem. It came before the iPhone, right?

Michiel: Ski Stunt Simulator[3] was about 8 or 9 years in advance of Angry Birds, and so, in part, I don't think I was aggressive enough with the business side of things with respect to monetizing all the attention that it was receiving. At its peak, the simplified online java version was getting hundreds of millions of plays per month! But at the time, ISPs were charging a fair bit for data. So, for all the visits to the web site, we should have moved to selling pay-per-view ads, as well as generally pushing it in other directions, including for mobile when the iPhone came out in 2007. But I have absolutely no regrets. Running the business side of things was not something that I found exciting, and when running a business you need to be 120% invested in running it, and I still had many interesting problems that I wanted to solve related to motion control, animation, and graphics in general. But I can't tell you how great it was to get all the positive feedback. It is just difficult to beat that! I would get many emails such as "this is the most incredible thing, ever," which is a pleasant contrast to the at-best muted-enthusiasm that you get on anything from academic paper reviews. The game had a surprisingly broad appeal. People later dissected the code and wrote their own levels for the game with absolutely no support from myself, and you can find these things on YouTube[4]. It managed to capture one of the joys of sports, namely the creative part. The fun thing about physics is that it gives you a set of rules to play by, but then you can do really incredible and creative things. Playing with the game mechanics was the fun, much like Minecraft just lets you be creative in exploring things.

Paul: What do you think is your most under-appreciated paper?

Michiel: I'm a big believer in the progressive nature of learning and that it is a critical feature to learning anything complex, such as how to move in a variety of settings. We captured some of these ideas in our Continuation Methods paper [21], and we generalized this in nice ways in Andrej Karpathy's work [7]. These papers have gone largely under-the-radar. The dynamics of what makes a paper "popular" can be quite fickle! In machine learning, curriculum-based learning ideas are beginning to see traction [1], and Karen Liu's group is also pursuing exciting ideas in this direction [6].

Paul: Looking through your earlier papers, I'd also like to hear your thoughts on some of your early GI papers, two of which stand out for me. What about the cat quadruped paper from 1998 [15] and the virtual windup toys [18]?

Michiel: For the latter, the insight was really from the sensor-actuator networks paper that a lot of the searching, simulated annealing, and it was really just searching for motions that would lead to cyclic behavior. So why not just give it a cyclic structure right away rather than looking for ways that might give rise to cyclic behaviour. The work we did much later, the 2011 quadruped paper [2], is in some ways really just a much fancier version of the windup toys with additional balance mechanisms, better optimization, and taking advantage of reference motion data when available. It is surprising how often you can come back to earlier ideas and realize that you actually had an idea right early on, and realize that it needs to be revisited with the current state of the art in computation, optimization, and reference data. And you need to have the confidence to pursue this. But this is not a good pitch for a grant proposal *[laughing]*. The same logic also applies to another paper we wrote, Motion Synthesis by Example [8]. This was an early version of parameterized motion graphs, only we populated it with data from a physics based simulation and key frames, rather than mocap data. And we also introduced the mass-distance metric as a good distance metric to use between poses and motion clips, which has since been reused by others in many settings.

Paul: So that was a full 6 years before all the motion graph papers came out!

Michiel: Yeah, but it was just done for planar motions, and that is where we made a mistake because we should have more aggressively pursued applying the same ideas to large collections of 3D motion capture data.

Paul: To come back to something that came up a bit earlier, do you think there has been sufficient adoption of physics based characters in games, and other applications? Where do you see the greatest success, and what has been the main block to adoption?

Michiel: For adoption, there needs to be middleware that makes physics based characters really easy to use for various applications. We are on the cusp of seeing this happen. We have a TOG paper that is about to appear [9] that makes some significant strides in terms of being able to automatically convert motion capture clips into robust controllers as well as integrating them into a connected graph so that the various skills can be easily sequenced. I'm really excited about where that may take us. Ideally all of these skills should live in the cloud and you download the subset of skills that your character needs. Moving forward, there is a lot of room for cross-fertilization (and competition) between the constant flow of ideas coming from robotics, AI/machine learning, and physics-based animation, in terms of making progress on models for skilled human, animal, and robot motion.

Paul: What do you see as the greatest challenge for the community in the coming years?

Michiel: It often feels like the pace of research is accelerating. What is the best way to keep up with the large firehose of new information and new papers that appear each year? The work at the cutting edges of graphics and animation is becoming increasingly specialized, although at the same time it is increasingly intersecting other fields such as computer vision, robotics, human perception, HCI, machine learning, VR, and so forth. Another challenge is convincing the broader scientific community that graphics and animation is not a "solved" problem. I feel this in part due to the strong

[1] https://www.reddit.com/r/videos/comments/1v5gqn/computer_simulations_that_teach_themselves_to/

[2] https://vimeo.com/79098420

[3] http://www.cs.ubc.ca/~van/sssjava/javademo.html

[4] Searching for "ski stunt simulator" on YouTube will pull up many examples.

association with the visual effects and game industries, where it can be difficult to distinguish between the contributions of artist-driven efforts and the algorithmic results. I think that this may change soon, with new tools that let anyone capture models using their mobile phones, and new applications of graphics and animation, including the excitement about VR. We're really just getting started on "Imagination Amplification", which I think still remains an apt description of what graphics is about.

Paul: What do you think new grad students would want to know most before starting in the area of computer animation, or how could they best prepare? Or alternatively, are there any life lessons for new undergrads, grads, postdocs, or faculty? Words of wisdom?

Michiel: Hmmm, that's difficult. Much of what I'll say will sound trite. Test as much as you can in 2D before proceeding to 3D, particularly for physics and animation ideas. Enjoy the serendipitous nature of research; in my experience it rarely stays close to the milestones that are listed in a research proposal. Embrace change; there will be plenty, so enjoy the ride. Be humble; there is always something to learn from a situation or from others.

Paul: What is the most exciting thing you've seen in recent years? Something you've found to be inspirational? Perhaps with robots, art, or something else?

Michiel: I think that the confluence of advances in computer vision, robotics, sensing, displays, mobile technology, 3D printing, and affordable prototyping all points to an increasing number of ways that we can connect the real and the virtual. In the past, graphics has been rather constrained to the virtual world, given the effort needed to import or export artifacts from-or-to the real world, or the challenges of building good real/virtual hybrid models. But now the doors will be open to all kinds of new possibilities and "fabrics" that mediate how we experience work and play.

Paul: Knowing that you are passionate about cycling, I wonder if you plan to bike to GI 2016 this year? Or perhaps there are not enough hills along the way?

Michiel: Exactly, although there is Ryder Hesjedal's Tour de Victoria[5] that I'm seriously considering participating in. There is a half marathon in Oak Bay, Victoria, the weekend before GI, so I'm signed up for that! I have a bit more training to do. You should sign up for that if you will be on Vancouver Island a few days early.

Paul: Sounds like fun! Anyway, thanks for this conversation and sharing your insights with the community, and of course, congratulations again!

Michiel: My pleasure! I really appreciate this type of interview format. I think that science often does itself a disservice by not doing a better job of providing ways to include "the story behind the research".

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