A Conversation with CHCCS 2021 Achievement Award Winner Pierre Poulin

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ABSTRACT

The 2021 CHCCS Achievement Award from the Canadian Human-Computer Communications Society is presented to Prof. Pierre Poulin (Université de Montréal) for his contributions and leadership in the field of computer graphics. His research has had a lasting impact in areas spanning rendering, modeling, and animation. He has been a leader in building the graphics research community over time via research mentorship and sustained organizational efforts in support of computer graphics research in Canada and in Europe. CHCCS invites a publication by the award winner to be included in the proceedings, and this year we continue the tradition of using an interview instead of a formal paper. What follows is an edited transcript of a conversation between Pierre Poulin and Michiel van de Panne (UBC) that took place on April 10, 2021, via Zoom.

THE INTERVIEW

Michiel: *So first of all, congratulations with the CHCCS achievement award!*

Pierre: Thank you – it is really a great honour. For me this is even more special as I reflect on the fact that Alain Fournier, my MSc and PhD thesis advisor, was one of the first recipients of this award. It was a great pleasure to get the announcement.

Michiel: *Can you tell us a bit about what first drew you to graphics?*

Pierre: I could probably spend three hours talking about that, but I'll give you the short version. This begins with my path through computer science at Université Laval in Québec City, and understanding how limited my knowledge of English was at the time. I come from a small town (proudly, St-Joachim), East of Québec City. During my first year(s) as an undergrad, I would read the mandatory CS and math textbooks in English with a dictionary next to me, because I needed to translate them word by word before understanding the material. So I translated most of the chapters to French and I was making copies for my friends.

Unlike several colleagues, my undergrad course on computer graphics did not generate much enthusiasm. As an undergrad, I worked instead with Pierre L'Ecuyer, now world-renowned, on pseudo-random generators and libraries to test them. Having my name in the acknowledgements of his first paper in *Communications of the ACM* was really exciting. But I had not given up on graphics, and I completed a term project on a visibility algorithm for clipping triangles. Not having any display system at the time, my final "image" was a table of visible clipped triangles coordinates from a hand-crafted set of diverse configurations.

By the end of our three-year program, I was awarded an NSERC post-graduate scholarship, but I decided to postpone it in order to get out in the "real world". We then fast forward to a short 10-month employment as system administrator on large IBMs in the Québec government, which convinced me to accept the scholarship. At that time, I understood that to make any real contribution, I needed to improve on my English. And so I left do computer graphics in Toronto with Bill Buxton, whom I had met earlier at an electronic music show with his band in Lévis. Little did I know that Bill was actually famous, but in HCI, and that he would not be at the University of Toronto when I arrived in early summer.

So when I actually started graduate school in September 1987, I was heading to work with Ron Baecker, when I first met Alain Fournier, just back from sabbatical, and he accepted me as a Master's student. It was really exciting to be part of the DGP lab, where there were so many great students working on computer graphics, including Andrew Woo, Avi Naiman, John Amanatides, John Buchanan (who also started in HCI), who all knew everything about graphics, programming, systems, computer science, and math. I showed up as a new guy, with so much to learn, while trying to improve my English with lots of smiles at my mistakes. It was really fun and the lab was bursting with ideas.

Michiel: *Was there anything in particular that led you to the research directions that you took?*

Pierre: I told Alain that I wanted to work on clouds. In his typical way, Alain said "anything can look like clouds, and clouds look like anything," and he dug up a recent paper from Kajiya on anisotropic reflectance, saying that "this is a nice topic, you should look at." That started me in the direction of modeling anisotropic surfaces for my Master's degree.

This led to investing much time in Kajiya's model, then a separable model, fruitful discussions with visitors Ken Perlin, Tomoyuki Nishita, Marie-Paule Cani, sketching figures with Mikio Shinya and Marie-Claire Forgue, throwing anisotropic Xmas balls and bowls from Honest Ed's in a lab Toronto-Waterloo visit, and extending anisotropy to linear light sources; I remember these flashes of intense research that were so productive!

Then John Buchanan and I moved to Vancouver with Alain, to start the new Imager lab and to continue our PhD studies at the University of British Columbia. Instantly, we became the senior students in the lab, trying to give back to the new students what so many at DGP generously gave us.

Michiel: *In terms of working with your students and collaborators, can you describe some of the unpredictable paths taken and the serendipitous nature of research?*

Pierre: Very often when students come for initial discussions, I try to find the best fit possible between personality, what they like and know, and topics that I know are exciting and rich in open problems. In some cases I have some basics already sorted out, and students then go further. In fact, as a new professor, projects were really carefully planned. As experience and intuition evolved, many more of my recent projects are planned in less detail, which takes us in a broader set of directions, providing more freedom to the students' visions.

Some of the best surprises come when a student completes an MSc, and with or without a pause in industry, continues onto a PhD on

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a different topic. One of the best examples is Philippe Beaudoin, where we worked on modeling fire for his MSc and then went onto working on motion capture for his PhD work. This also had natural connections to the earlier days of machine learning. One day, Yoshua Bengio came across our work when looking into ML problems in animation and robotics, because Philippe had used ML methods to learn and extract motion motifs and motion graphs from mocap data. Luc Leblanc also worked on guaranteed full occlusion in global illumination for his MSc, to return for his PhD to a very powerful block-based primitive for procedural modeling of buildings. Some research also surprised me, for instance how Simon Clavet's contagious enthusiasm for 2D and 3D SPH demos and deep intuition turned into my second most cited paper. Alternatively, in other promising research directions, results were so much more difficult to turn in a paper. I often faced those challenges with GPU implementations, for example.

Michiel: *How do you work usually with students?*

Pierre: With my strategy to fit or develop a project for each student, very few of my graduate students have contributed to a common system, or started from a previous project to move it further. This means that each student is fully responsible to implement his or her environment, to demonstrate new research results, and to co-write the paper. This adds stress for making everything work in a timely fashion, but it also teaches much about building a complete system. In some cases though, students helped each other enough to lead to co-authorship on papers, and I must say that some of these team efforts were quite special.

In fact, I really appreciated the ambience of being in an active lab during my graduate studies. I tried to replicate its success in my lab at UdeM. There is a supportive enthusiasm in sharing daily routine, knowledge, difficulties, and successes that are unique in research. This forges friendships for life. Between generations of students, the ambience and activities may change, but the support and friendships remain.

Every Summer, I organize a lab's BBQ in my backyard, where 20-40 people from different generations, some with their spouse and kids, come and share experiences, tell stories, discuss the latest technologies, tease each other, etc. This is one of my best moments of the year.

Michiel: *As researchers, sometimes some of our best work goes unrecognized. If you had to point to work of yours that you feel has flown "under the radar" and deserves further attention beyond what it has received to date, what would that be?*

Pierre: Maybe two papers come to mind, both related to geometry processing. The first paper is about geometry images, a nice representation that reverses the role of texture mapping and mesh geometry [1]. Our main contribution is to generalize the mapping over arbitrary genus meshes, but in doing so, it goes into several theories and methods that we thoroughly enjoyed learning and exploiting. It gathered only 5 citations. The second paper is about using dihedral angles of tetrahedra as the fundamental parameters to transform the shape of volumetric objects [2]. It was very well received by the reviewers at SIGGRAPH, my best scores ever, but it gathered only 15 citations.

Michiel: *A number of your students have been involved in spin-off companies. Can you describe how that happened?*

Pierre: First, let me just say that it was always crucial to me to steer well clear of any conflicts of interest, or any appearance thereof.

I was always interested in capturing information from real photos. The origins lie with some of the work done during my short postdoc in Princeton with Pat Hanrahan, and even earlier with work done with Alain, where we painfully hand-crafted a scene and camera parameters, mixing reality and synthetic objects from a video, in support of global illumination effects. And so, in my first years as a professor, my students and I developed a number of manual and more automated reconstruction systems, based on traditional computer vision approaches, but with a computer graphics perspective and user interaction aimed at high-quality geometry, textures, reflectance, illumination, and renderings needed for special effects. In my last such system, With Emric Epstein and Martin Granger-Piché, two highly motivated MSc students, we worked with handheld cameras and mirrors, exploiting video projectors to project features onto the scene in order to be able to better capture various aspects of the scene. This work turned out more difficult to publish because it used traditional computer vision methods but for graphics applications. Via a serendipitous connection, Moment Factory approached the students for some special tracking in one of their projects, and we designed a solution for them. The students then realized how our applied research philosophy was lacking in the live entertainment industry, and we created a startup: three graduated students, with very little guidance from myself, mostly at the first stages, and with the help of early entrepreneurship awards.

Now the company, VYV, has been around for nearly 17 years. They completed several major projects with Cirque du Soleil, Franco Dragone, Robert Lepage, etc., various festivals, National Day shows, as well as live Tour shows of Justin Timberlake, Ariana Grande, Roger Waters, and more. The work examines many aspects of visual productions from the early stages of production design, and provides solutions for where to place projectors, how to perform capture and reconstruction, how to track people and project onto them, and so much more. Our flagship hardware/software, Photon, completely developed by VYV, was used on all our projects.

Michiel: *What have been some of the key inflection points in computer graphics for you?*

Pierre: When the Personal Iris from SGI came with a 24-bit color framebuffer, that was really exciting and changed the way I thought of computer graphics. Instead of uploading an image onto one external framebuffer, shared by all of DGP members, we could interact directly with high-quality rendering. This opened the way to a series of my projects where users were involved in the rendering process, as well modeling, animation, etc. A second major step came when powerful GPUs, in my case the first GeForce from NVIDIA, migrated to simple PCs. That had a huge impact by really lowering cost of doing computer graphics, so that more money could go directly to the graduate students. The current status of multi-core CPUs with access to huge memory, and more flexible GPUs now in floating-point all continue to change the way we do graphics.

In contrast with many of the methods that my students developed, with so many fine optimizations to achieve reasonable compute times, many of our current efforts instead follow a strategy of "simple is beautiful," which will make it parallelizable, easy to maintain and to extend. Now we have the machine learning wave and the use of graphics is an exciting avenue to generate examples to learn from, and to test learning strategies on.

Michiel: *What is an important unsolved problem in computer graphics for you?*

Pierre: Something that continues to surprise me is the difficulty of rendering shadows. It was a real pleasure to rework with Andrew Woo on our book about understanding all the algorithms and figuring out their strengths and limitations. Even with so many methods that have been designed and refined over the years, they still break in different ways. It still remains an open problem in practice.

Another more obvious (very) long term open problem has been motivating generations of computer graphics, computer vision, and now machine learning communities: Understanding the content of photos, capturing the appropriate level of information, reconstructing geometry, textures, reflectances, incident lighting, and global illumination. There are thousands of papers solving parts of the problem, but with the exception of special constrained situations, the quality is rarely at the level expected for many computer graphics applications. I am convinced there are still thousands of papers to come, and more with video sequences of vibrant cities, splashing waves, hair flowing in the wind, and more. It is exciting to think about what new specialized cameras and sensors can bring. And then, to give the results to artists to modify, animate, and create synthetic content with ease.

Michiel: *Any advice for students getting started in graphics now?*

Pierre: I started my Master's dissertation with "Look around you, light is everywhere", and Andrew Woo responded in his dissertation with "Look around you, shadows are everywhere". That "look around you" has kept me going in terms of research ideas. I often wonder how I could render something, animate it, and design tools for artists.

My approach to research (and even more so when I had more time!) has been to read many papers in computer graphics, but also on different topics. You don't need to understand everything in a paper, but you should get the gist of it, so that you may connect dots later on. That is key to being able to do research. Dive into what excites you and don't go too deep into a paper that doesn't excite you. Extract broad knowledge, make connections, and when necessary, you will find the motivation to go deeper into the details. Having the interest and motivation really matters. Trying to understand everything is almost impossible. Identifying the fun part should be a priority.

Michiel: *Any closing thoughts that you wish to share?*

Pierre: As a university professor, you must divide your time to fulfill many duties, and run from one deadline to another. For most of our career, we have very few constraints from our "boss". But being your own boss can be extremely demanding.

Having good relations with my students has been key to enjoying this demanding lifestyle. There is a fine line between challenging students to continue to do better, and making sure that they are happy and learning, without solving everything for them. And while I did not always understand how to motivate a student, I have been blessed that a great many of my graduate students are still among my best friends today. Looking back, more than results and papers, I'm most proud of my students, what they've learned, what they've achieved, and where they are now.

My life has also been much enriched by my collaborators and colleagues. We have a special wonderful national and international community, supportive, exceptionally strong, and very friendly.

Michiel: *Many thanks again for the splendid conversation, and congratulations again!*

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