

A conversation with CHCCS 2018 achievement award winner Dr. Gordon Kurtenbach

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ABSTRACT

A 2018 CHCCS Achievement Award from the Canadian Human-Computer Communications Society is presented to Dr. Gordon Kurtenbach for his many contributions to the field of human-computer interaction (HCI), especially his work on novel interaction techniques for gesture-based and pen-based interfaces, his leadership in building arguably the most successful industry-based computer science research group in Canada, his exemplary role promoting collaboration between universities and industry in Canada, and his active mentorship of some of the best young Canadian researchers in the field. CHCCS invites a publication by the award winner to be included in the proceedings, and this year we continue the tradition of an interview format rather than a formal paper. This permits a casual discussion of the research areas, insights, and contributions of the award winner. What follows is an edited transcript of a conversation between Gordon Kurtenbach and Kellogg Booth that took place in March 2018.

THE INTERVIEW

CHCCS: Hello Gordon. Congratulations on receiving a 2018 CHCCS Achievement Award.

Gordon: Thank you very much! I feel really honoured and humbled to be getting this award. Looking at the list of past award winners, it's an impressive collection of people, some who were colleagues and others were the folks I looked up to in the Canadian research scene when I was a grad student. So to join those ranks really means a lot to me. Any accomplishments I may have achieved, have been made through working with so many really talented people. Bill Buxton took me on as Ph.D. student and got me some of coolest jobs and got the first Alias research group going. George Fitzmaurice and Azam Khan partnered with me to take the risk and build the Autodesk Research group. Folks like Eugene Fiume, Jeff Kowalski, and Carl Bass helped too and had faith in our industrial research approach. There's so many others – when I see them I will thank them!

CHCCS: Your doctoral dissertation was one of the first explorations of marking menus [6]. Looking back, did you have any idea then how important your ideas would eventually be for user interface design?

Gordon: No, I didn't have a sense of the eventual importance. When I was doing my dissertation, I did have a sense that the ideas I was researching would have practical value. I had been experimenting with "gestural" interaction for a while, back around 1989, at the same time companies were starting to put out pen-based computer systems. There was the Apple Newton, Go Corporation's PenPoint, Microsoft's PenWindows, Momenta's Pentop Computer, etc. I'd finally gotten to the point in my research, or beliefs, that I didn't think anymore that a pen, as an input device, was a hands-down winner.

However, the companies trying to sell those early pen-based computers were banking on that. You know, everyone made the argument that it was "natural" to use since we all knew how to use a pen. However, in my early GEdit [5] work, I found that it wasn't true. In fact, in some ways the users' expectations around using a pen made things worse. I remember showing GEdit at a University of Toronto research open house, where people came in off the street into the lab and we would show them our research. I described to people how I was using a simple language of markings to create and move around some simple graphics. Everyone politely listened to me give those instructions, but when I gave them the pen, they just tried to write their names! So, for me, it was the lesson that interface design is more about managing user expectations and learning than finding some "natural" mode of interaction.

I had that observation and then later when I was at Xerox PARC, daydreaming during a summer internship, I had the insight that a path through a set of pie menus could make a unique mark, and that was the invention of "marking menus." It wasn't until two years later, sitting on the floor in Bill Buxton's basement reviewing a draft of my thesis, that Bill pointed out that the key idea was, in general, how to get novices to easily learn expert behavior. I credit Bill with first really seeing that clearly. I remember thinking at the time "I wish we would have thought of that when I started the thesis!" But, hey, that's why it's research.

I did realize how this general idea of novice/expert performance was important, and I did have some ideas about how it could be applied to things beyond marking menus, but I had no idea how much others like Shumin Zhai, Carl Gutwin, and other great researchers would build on it. That's been amazing to watch.

For general user interface design, every time I see someone swipe left or right on an iPad or iPhone, it gives me some satisfaction that Thomas Baudel and I were experimenting with that gestural interaction way back in the early 1990s [4]. I have no idea if the designers at Apple ever saw our work, but certainly it was the research community's continued exploration of these techniques that probably made the Apple designers consider gestures, so it's nice to be part of that heritage.

CHCCS: Classic GUIs, or as they later became known, WIMP interfaces ("Windows, Icons, Menus, and Pointing devices"), were the dominant approach for well over a decade when your marking menu work was underway. They date back to ideas that Doug Engelbart and his colleagues at SRI first introduced in the 1960s [1]. Much of the focus in HCI when you were a graduate student was still on GUIs, but there was already discussion of post-WIMP interfaces that would go beyond classic GUIs [11]. Do you see marking menus as part of a bridge from WIMP to post-WIMP?

Gordon: I don't really see WIMP and post-WIMP as distinct things. Certainly marking menus, specifically as they are implemented for desktop systems, are optimized for that configuration. However, a mechanism for "fast menu selection" could be needed in post-WIMP interfaces too, so they could be adapted to that context, and we've seen that already in the research with bimanual marking menus, etc. However, the basic concepts that marking menus

are founded on – the novice to expert transition – are independent of WIMP/post-WIMP distinctions. To me it's like Ben Schneiderman's original work on eight basic interface principles: objects should be visible, operations incremental and reversible, etc. [9, Section 3.3.4].

CHCCS: Even earlier there were the principles identified by Jim Foley and Vic Wallace in what I think is one of the classic papers in HCI [3]. Their list foreshadowed a number of more refined sets of guidelines, including Ben's.

Gordon: Right. These are basic properties that if you don't have when interacting with technology, then you generally get something that is difficult to use. I put the general ideas behind marking menus in the category of the "universal golden rules" of interaction design.

CHCCS: There has been lots of recent interest in AR/MR/VR (augmented, mixed, and virtual realities) that seems to be spurred by VR gear coming on the market at consumer-level prices. Is this just a bubble, or has VR really "arrived" after all of the false starts in the past?

Gordon: My current opinion is that AR/MR/VR has arrived, but it's not as big a deal as VR fans have always made it out to be. For example, in designing our new lab space at Autodesk Research, we had some areas with low ceiling heights. The architects said it would be OK, but I was really concerned that it would feel too low. So, we loaded the 3D model of our space into the Autodesk 3D VR viewer and spent time walking through the virtual lab. It seemed OK in VR, so I figured the architects were right. I approved the design. For a two-year building project, we spent about 10 minutes in VR – but it was totally useful because it helped us make the right decision. So, I think the idea that VR is some really general "desktop replacement" may never happen, but instead VR is really just joining the ranks of display technologies that we can use for specific tasks. As a friend of my mine said, "VR is just another window in an application."

CHCCS: I wanted to come to back to the term "GUI" and ask you about the evolution of computer graphics and HCI as distinct fields. Certainly at one point the two seemed to be closely intertwined, especially in the era when GUIs were first introduced and the WIMP paradigm was becoming dominant. Autodesk had its roots in interactive computer graphics, primarily for modeling in CAD (that was how Autodesk got started) and modeling and rendering for animation (that was how Alias got started). Concern about user interface design was obviously part of what had to be built into those early systems. Do you see the separate evolution of the two fields as something that has perhaps lost some of the advantages of the early years when advances in one fed into advances in the other? Or has the evolution allowed both to advance even more and perhaps feed-back into each other from time to time?

Gordon: I think the separation was a bad thing. Maybe not so much in terms of the separation of the fields of research, but more I think that user interfaces for 3D products have become stagnant. In CAD, the industry seems to have settled for a style of UI design, especially in 3D views, that is circa 1996. Around 2007, my research group did a bunch of work to improve 3D navigation in the CAD context. We got that into Autodesk products, and there were some valuable interactions like the "viewcube" and "steering wheels." However, this required a Herculean effort, because the installed base of CAD users had become used to the jumble of crappy 3D interaction techniques from the past. People can master the violin, so they can master poor 3D navigation interactions. So we put up with it. As an industry, in terms of interaction standards, we are trapped in a local minimum by this backwards-capability issue. I've been disappointed that even when opportunities come along to

break out, like the rise of the iPad, 3D apps on those devices most of the time are just a transfer of the old 1996 concepts.

For me, as much as I love to improve GUI interfaces, the work of our group has in recent years focused not so much on interaction as it has higher-level disrupters. Specifically, things like Generative Design (as opposed to manual design) and tools to support learning that don't worry about the details of interaction but more focus on trying to produce massive improvements in the higher-level tasks that users are doing. Having said all that, I would still love to re-think interaction for 3D modelling and animation using all the research over the years, like bimanual input, marking menus, 3D manipulations, etc. But the business case for that in the CAD world is very difficult to sell. That's not unique to CAD or Autodesk. For example, Microsoft Word still has the same interaction model it had in the beginning. Even when Google started fresh with Google Docs, they didn't do a big "rethink" of how an office suite should work. They largely copied Word and Excel. This is why understanding UI design in terms of skill acquisition and transfer is critical.

CHCCS: In 1996, your uncle, Nestor Burtnyk, was the fifth person to receive a CHCCS Achievement Award. There have been a couple of years when the winners were the academic offspring of previous winners, but I think this year is the first year we have honored someone who is a close biological relative of a previous winner. Did Nestor's early work in computer graphics and human-computer interaction at the National Research Council have any influence on you and your decision to work in these areas?

Gordon: No, not at all in the beginning. I'm a little embarrassed to say that it wasn't until I was taking the advanced topics in computer graphics graduate class at the University of Toronto with Ron Baecker that one of Nestor's papers came up in the readings. I never met Nestor when I was growing up – I was on a farm in Saskatchewan and Nestor was at NRC in Ottawa. My mom, of course, knew about Nestor, but her other brother was also a pretty accomplished electrical engineer too, so as a kid that was all blurred together for me, quite distant, and, of course in a kid's world, not relevant.

However, I do remember my mom telling me that Nestor "used a computer to make the music for the CBC national news," plus there was something he did with the National Film Board. Those stuck with me, so when Ron Baecker mentioned Nestor's and Marcelli Wein's paper [2] and their work on the 1973 animated film "Hunger," it pinged a memory that "Oh yeah, my mom mentioned that Uncle Nestor did something like that." Then, when I dug deeper into his work I thought "Wow, this is really cool" and it seemed very avant-garde especially their work with Peter Foldès on "Hunger." So suddenly, I had this distant relative who apparently had done this super cool research! Since then I got to know Uncle Nestor more. He's such a humble and practical guy. Ironically, I realized at Alias that I was still working on many of same problems as he had because they really are tough and we still don't have the best solutions.

The funny story about Nestor's 1996 CHCCS award is that one day Bill Buxton mentioned to me, in passing, that he would be giving the CHCCS Achievement Award to Nestor Burtnyk at some exclusive evening event in Toronto. Bill didn't know I was related to Nestor. I casually said: "Yeah, I know, and I'm going, and some of my family will be there too." Bill got this look on his face that he seemed to think I was bizarrely confused, and we said nothing more about it to each other. Later on, at the event, Bill showed up and I said "Obviously, you know my Uncle Nestor, but here's my Uncle Wayne and my Mom and Dad." We both had a huge laugh, and Bill was completely tickled at the craziness of the surprise. It's a great memory where all those worlds finally met!

CHCCS: I think anyone who knows the history of the computer animation software industry realizes that Canadians, and Canadian companies, played a very significant role in the development of the industry and they continue to do so today. What do you think led to this?

Gordon: There were a number of factors. Certainly, the Canadian government's support of the arts, going way back, was important. Especially, in the early days, it seems to me that a lot of interest came from animators at the NFB. That's where Nestor and his colleagues at NRC connected with real animators. Obviously, there was an East Coast effect. When I came to the University of Toronto in 1986 there already was animation research going on. Cornell University where Don Greenberg's group was working on techniques that Hanna Barbera later adopted was close by, and folks at Brown University were doing work too. Ron Baecker had come to Toronto from Lincoln Labs at MIT. All this led to Alias, Softimage, and a number of other companies starting up. So I think it was because Canada was a little ahead on the research in some ways and we reached a critical mass of interested people and that became a sustainable advantage.

CHCCS: Before joining Autodesk (it was still called Alias then), you worked at Apple and later at Xerox PARC as a student intern while you were completing your graduate work. How did that affect your career choices?

Gordon: Both Apple and Xerox introduced me to the rarified air and life style of corporate research. As a student, there was nothing but upside: freedom to pursue my interests, some degree of support for my ideas, working with super smart and really nice people, and somebody was paying me! I had no master plan for a career, besides getting a job that pays well, wasn't too boring, and had lots of flexibility. Actually, my master plan after high school was to become a rock star, so the computer thing was just a day job to pay the bills. Luckily, the computer side of things turned out to be really interesting. Growing up on a farm, I didn't mind hard work, but in so many ways working at Apple and Xerox just seemed to be an extension of being a student, so I just kept on going in that groove. When Bill Buxton called me up and said he wanted my help to start a research group in Toronto, by that time I was in love with HCI research, not so much the science part, but the love of building and improving stuff.

Speaking as a researcher, Apple was an early lesson in the chaos of a modern corporation. When you are a student intern, only responsible for your project, the chaos seems like a fascinating jungle with exotic creatures of all variations. Now that I'm head of a big group, responsible for delivering strategic foresight for a publicly-traded corporation, the chaos of a modern corporation feels more like a farm where you are trying to plan crops, experiment with seeds, remove some weeds – but not too many weeds, predict the weather, etc. There's a lot of stuff going on, and in the research world, chaos is sometimes a foe and sometimes a friend.

At Xerox PARC, the thing I learned, besides all the deep, impactful work that has happened at PARC (ethernet, desktop UI, ubiComp, to mention just a few), is that how you think about things and conceptualize them is hugely important. I got some exposure to this at the University of Toronto in grad school, but Xerox PARC was a building just full of brilliant thinkers. I remember some of my first conversations with Stu Card and Tom Moran about ideas for my Ph.D. and I was blown away by how easily they riffed out interesting ideas or different ways of looking at things. At PARC there was always this feeling that you were scheming about how the future of technology could unfold. It was tremendously exciting to do that in an environment where that was encouraged.

CHCCS: How important do you think it is for students to get industry experience as part of their graduate training? Is it different if they are expecting to work in industry or if they are hoping to get an academic job?

Gordon: I would try both. Some people thrive doing product development. Other people hate the constraints of "getting a product out" and love the exploration aspect of industry research. I have had people who have tried research and gone back to product development because they weren't comfortable with the nebulous nature of research or how you have to be very comfortable working with very undefined situations at times.

Certainly, I can tell when I talk to folks in academia who haven't worked in industry. The number of things that have to happen to ship a product is staggering, so until you've been on the hook for it, you don't appreciate things like regression bug testing or customers that are delighted or frustrated. It's actually a lot of fun. For me, when I was doing development work it was very cozy: come in the morning, see what bugs you needed to fix and spent the rest of day fixing them. All predictable and rewarding.

On the other hand, I can tell when I talk to people who have never done research. Many times they can't distinguish between discovery and refinement and the value of both. It's like as a researcher you say "I've discovered how to split the atom," and a non-researcher says "Yeah, but the hard part is building the super complicated reactor...can you help pour the concrete?" I credit Eugene Fiume for making me understand that research is about discovery: "can it be done at all?" or "does it exist?" and product development is about the timely and orderly manufacture of something. Lots of people combine those. Sometimes it's genius. Sometimes it's a disaster. Recognizing the differences is critical, and that's why smart folks like NASA developed their technology level classification schemes [7].

CHCCS: Do Canadian companies provide enough opportunity for student interns?

Gordon: I suspect not. I know for Autodesk, in Canada, we love having student interns. Many of them come back and do an internship in our San Francisco office and my colleagues there have been blown away by the quality of these folks. I've been surprised at times by this reaction, and that's because I've become used to very high-quality students, so that's a big compliment to the Canadian education system.

On the research side of things, student interns don't really have that many options in Canada. In my own case, in retrospect it's disappointing that my internships were all in the U.S. Really, there were no options for me in Canada at the time. That's changing a bit now. Obviously, there's my group in Toronto that's going strong, but also there are other companies like Royal Bank of Canada that have started AI research groups. Plus, the big global companies are starting AI labs here in Canada, so those efforts will give a landing place for student interns and in turn keep invigorating the innovation scene here in Canada.

I think in Canada we are in this transition period. With the demise first of BNR, then Nortel, and most recently RIM, we've lost that layer of large-scale Canadian R+D firms that helped nurture Canadian talent. This is why efforts like the MaRS Discovery District in Toronto, the current federal supercluster initiative, and many of the pan-Canadian innovation initiatives are so important, not to rebuild that past, which was far from perfect, but to get Canada's innovation, and research, really rolling. At the end of the day, all of these initiatives and many future companies will be driven by the student interns of today. So, it's great if Canada invests in internships and in creating future leaders. As my boss, Jeff Kowalski, said, "Lets

back up the truck and fill it up with Canadians.” He meant that in a very positive way!

CHCCS: The NSERC Synergy Award that Autodesk and the University of Toronto received in 2011 recognized the exceptional collaboration over more than two decades between researchers at Autodesk and the Dynamic Graphics Project. Are there things that the federal and provincial governments might do to encourage both companies and university researchers alike, including students, to more meaningfully engage with each other?

Gordon: Yes, it was great to get that recognition. When we got the award, Eugene Fiume, and I reflected on the amount of activity that went on between Alias/Autodesk Research and the Dynamic Graphics Project. There was always this casual flow of top-notch people back and forth, lots of internships, etc. It was largely based on personal relationships – we all liked working with one another. So it wasn’t like I just wrote a cheque for a million dollars to facilitate collaboration between U of T and Autodesk. It just naturally happened over the years, really based on the flow of research students between our groups.

I’d like to see more government programs that really reward this type of activity. For example, every year we apply for government R+D tax credits, and there’s large range of activities that fall into this category. It runs from true, publishable research, to what is basically software development. I think it’s great for the government to encourage both, but if you really want to competitively separate Canada from other countries on the innovation front, you need to especially recognize original research. Most companies will do the development work as part of their business but will often underfund the research, which means they are weak in strategic foresight. Hence, we end up with companies and a country that do not reinvent themselves without a lot of turmoil because we fail to see or, even better, lead new technology waves.

David Naylor, the former president of the University of Toronto, has said that part of the problem is that people confuse research with innovation and they make the mistake of thinking that basic, curiosity-driven research is a poorer form of focused innovation. I think he’s right that it’s a mistake. The key idea is that both reinforce one another and that’s why encouraging curiosity-driven research in industry, not just at universities, is important. It bridges the gap between research discovery and real-world impact. For example, both my work on marking menus and Jos Stam’s work on fluids [10] started because we were just curious about what could be done. Both those breakthroughs got quickly into products because we were hanging out in industry.

I’d also like to see more government program like Mitacs [8] that encourage companies to try out new things, like having a visiting research student or professor from a domain your industry doesn’t generally draw upon. Typically, in a company, there’s always pressure to focus your limited resources on innovation efforts that are the highest priority. This results in a list of things that are “maybe nice to have, but we aren’t really familiar with that.” But sometimes it’s the introduction of those new elements that results in surprising, dramatic innovations. Even if it doesn’t work out, these types of things result in a richer network of smart people who know one another, and in the long run, that’s really what drives innovative communities.

CHCCS: I know that you are very interested in sustainability and how the products that Autodesk produces can contribute to understanding and mediating the challenges we face related to a sustainable future. What has inspired you to pursue this and what do you think the rest of us can do to help this cause?

Gordon: As a kid, I did a couple of self-defined projects in grade school. This was in the 70s, so my first one was on “The Space Race,” the second one was on the “The Beatles,” and the last one was on “Pollution.” Out on the Prairies, at that time, there wasn’t a lot of obvious pollution, so my report contained lots of information about industrial pollutions like the Love Canal [near Niagra Falls in New York State] and the really ugly by-products of the chemical industry. So, like many people from my generation, that set my world view. When global warming and sustainability became popular in recent years, it really for me just connected back to that early set of values. Only now it was a really gnarly global problem.

What really got me interested in this area (besides needing to save mankind) was I started to see many pollution and sustainability challenges as user interface challenges. Specifically, we need to make sustainable behaviours the easier way of doing things. My pet peeve example is the recycling bin. At least in Toronto, it’s a confusing set of things that can and cannot be recycled. The computer scientist in me yearns for a definitive algorithm. The user interface designer in me wants a simple interface that makes recycling easier than sending stuff to the landfill. The technologist in me wants a robot to sort all this stuff out automatically. So I really think for sustainability to work, we, society, have to make sustainable behaviours the paths of least resistance, not make them more of a pain than polluting.

At Autodesk, as a company, we make software for people who make things – the world of man-made things. So, our inspiration is to make our software tools such that the path of least resistance is to design things that support sustainability. It’s a great challenge because it’s not simply about allowing users to select from a range of sustainable materials. Lots of the opportunities can be had by looking at our world as a technological system of interacting elements, and those elements, our buildings, our cities, and our transportation systems, just like food packaging, need to be designed with sustainability in mind. That’s the really exciting thing about technology: rather than creating a dystopian future world of soulless machines, I really believe there’s an alternate path where the human condition and the world condition are going in a very positive direction. I think that as technologists, who also care about humans, we can make a tremendous positive contribution.

CHCCS: Thank you very much for sharing your thoughts. I look forward to seeing you at the Graphics Interface 2018 conference!

Gordon: Thanks Kelly, and thank you CHCCS – it’s really an honor to get this award and it’s been fun to talk about past and future.

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