In this issue of *IEEE Control Systems Magazine* (*CSM*), we speak with 2014 IEEE Control Systems Society President

We also speak with six other IEEE Fellows in the control systems field.

Vincent Blondel is professor of applied mathematics at the Louvain School of Engineering at the Université catholique de Louvain (Louvain-la-Neuve, Belgium) and dean of engineering at the École Polytechnique de Louvain. He received an engineering degree, a degree in philosophy, and a Ph.D. in applied

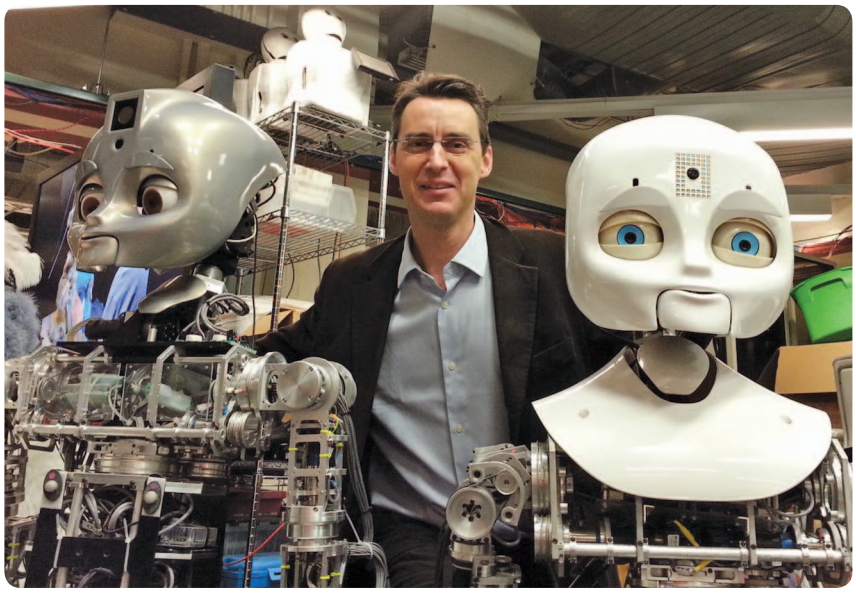
mathematics from the Université catholique de Louvain and an M.Sc. in pure mathematics from Imperial College London, United Kingdom. He has also completed a master's thesis at the Institut National Polytechnique de Grenoble (France). He is a research affiliate at the Massachusetts Institute of Technol-ogy (MIT), where he was visiting professor and Fulbright fel-low in 2005–2006 and 2010–2011. His major current research interests lie in several areas of mathematical control theory, theoretical computer science, and network science.

VINCENT BLONDEL

Q. How did your education and early career lead to your interest in the control field?

Vincent: For many years I felt that my initial choice to study engineering rather than mathematics had been a mistake. As a student, I read a lot on mathematics and on the history of mathematics. I was fascinated by works such as "A Mathematician's Apology" by Cambridge number theorist G.H. Hardy. Hardy would write things such as: "The mathematician's patterns, like the painter's or the poet's must be beautiful; the ideas like the colors or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics." I would read this and feel thrilled!

After my engineering studies, I went on for a master of science in mathematics at Imperial College in London and then completed a Ph.D. in control. For my Ph.D., I was first given papers to read in H-infinity control. This was the fancy topic at the time. I found these papers difficult to read and far from my attraction to pure mathematics. I then came across the very nice book *Control System Synthesis* by M. Vidyasagar. I could only understand its contents up to Chapter 6, but that chapter contained the description of a clearly stated problem: simultaneous stabilization of linear systems. This was a problem that was easy to state ("under what conditions are three linear systems stabilizable by the same controller?"), the problem had already been open for some time (it is actually still open), and the problem was mathematically clear. This was the perfect combination for my pure mathematics aspirations at that time, and I decided to make this the subject of my Ph.D. thesis.



Vincent Blondel in good company at the Media Lab at MIT.

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This was a quarter century ago. I no longer read Hardy and I now see things very differently—to the point that I even disagree with some of the statements made by Hardy. A couple of years ago, the king of Belgium, HRH King Albert II, was on a state visit in India. I had been invited with a few other academics to be part of the royal delegation. At the end of the first day, I was introduced to the king for a brief discussion. The king asked me what my research area was, and I replied "control theory and applied mathematics." The king, not a scientist by training, then asked "So, Mr. Blondel, what is control theory and applied mathematics?" I quickly figured out it was best not to start explaining Maxwell's governor or Routh's test, but there were plenty of other examples from applied mathematics to choose from. At the end of the conversation, the king told me: "Mr. Blondel, applied mathematics are very important." I believe the king was right, and I am now really happy that I chose engineering.

Q. What are some of your research interests?

Vincent: Frank Callier, a Belgian control theorist, had a very personal and colorful way of describing things. He once told me he chose his research interest by "analytical continuation." (In complex analysis "analytic continuation" is a technique to extend the domain of a given analytic function). I very much proceed by analytic continuation, moving to areas close enough that I do not have to start everything from scratch and can bring some potentially helpful perspectives but different enough to maintain my interest and not hit the same questions or difficulties again and again. Simultaneous stabilization, the topic of my Ph.D., was too hard to solve, so I tried proving that it was a computationally hard. In this way, I became interested in the computational complexity of control problems and started a fruitful collaboration with Prof. John Tsitsiklis at the MIT Laboratory for Information and Decision Systems (LIDS) that continues to this day. This collaboration extended to include many more colleagues and friends at LIDS and is one of the best things that has happened in my scientific life. For about a decade, we have analyzed the computational complexity of control problems and have shown many of them to be intractable. This interest drew me to hybrid systems, and in particular to switching linear systems and long products of matrices. And then by analytical continuation I reached network problems, then the analysis of large network data sets as a proxy for human behavior. Still, in continuation, I am now concerned by privacy questions. This path illustrates the power of analytic continuation; control leads everywhere!

Q. What courses do you teach relating to control? Do you have a favorite course?

Vincent: I teach courses in applied mathematics and computer science. Last year, I taught a course on the emerging field of complex networks, for which there are now a few good textbooks available. For the first time this year, I tried to flip one of my classrooms and had students watch lectures online first and then work on problem sets and interact in class. This approach is meant to allow the instructor to spend more time interacting with students instead of lecturing. My students took a MOOC (massive online open course), "Networks: Friends, Money, and Bytes" by Mung Chiang from Princeton University (on coursera), and we had weekly discussions about the course in class. MOOC courses offer visibility to scientific disciplines in ways that may be even more important than textbooks. I feel that a good MOOC introductory course in control on one of the most prominent MOOCs platforms would be beneficial to the entire control community. I have had my university join the edX platform but I do not see any control courses available yet.

Q. You are the coeditor of two books on open problems in control. How did you decide to coordinate these books?

Vincent: These two books are part of a larger initiative. I have always felt that researchers spend too much time explaining what they have been successful at rather than describing unsolved problems or things that they have attempted and that have not worked. I am not advocating describing at length how people fail but I feel that there is much to be learned from the genesis of a problem. With this in mind, and with the help of my doctoral and postdoctoral supervisors Michel Gevers and Anders Lindquist, I first solicited open problems and major challenges from prominent control theorists (this list was published in the first issue of the *European Journal on Control*). I then organized a special session on open problems in 1995 at the Conference on Decision and Control.

Profile of Vincent Blondel:

- *Current position:* professor of applied mathematics and dean of engineering, Louvain School of Engineering, Université catholique de Louvain, Belgium.
- *Visiting and research positions:* Petar Kokotovic Distinguished Visiting Professor, University California, Santa Barbara (2012–2013); visiting professor, Massachusetts Institute of Technology, Cambridge (2005–2006 and 2010–2011).
- *Contact information:* Avenue Georges Lemaître 4, boîte L4.05.01, B-1348 Louvain-la-Neuve, Belgium, +32 10 47 23 81, vincent.blondel@uclouvain.be, http://perso.uclouvain.be/vincent.blondel/.
- *Notable awards:* SIAM Triennial Prize on Control and Systems Theory, 2001; Fulbright Scholar, U.S. State Department, 2005; IEEE Antonio Ruberti Prize in Systems and Control, 2006; IEEE Fellow, 2012.

I vividly remember Roger Brockett siting in the front row. For any problem presented, he would ask: "What application do you have in mind? Is this mathematics or engineering?" He had an authentic interest in the session but insisted that control theory should help solve real problems. This session led me to coordinate the publication of a first book on open problems in control (with E. Sontag, M. Vidyasagar, and J.C. Willems) and then a second book (with A. Megretski). I wanted the books to be freely available on the Web and to be "living books," allowing the collaborative addition of comments, remarks, references, etc. The initiative never quite reached that level of interaction but one of the books is freely available on the Web, and some of the problems have generated considerable interest and research activity.

Q. What are some of your interests and activities outside of your professional career?

Vincent: My coauthor Jakob Stoustrup has this statement on his Web page: "This is what I do in my spare time." When you click on the link you get the response, "Spare time: what spare time?" I could have something similar on my Web page! I admire colleagues who are able to cultivate, in parallel to an accomplished scientific career, athletic or artistic talents at a high level. I have not been able to do so but, together with my wife, I greatly enjoy spending time with our three teenage daughters (ages 13, 15, and 17) and with our younger son (age 9), and I try to figure out how not to regret this very special time when it will have passed. I also occasionally play tennis and travel (and not only to conferences …).

Q. Thank you for your comments.

Vincent: Many thanks for asking! I love this section. There is no Web-like analytics for magazines but if there was, I am convinced this section would have a high PageRank!