

## JULIEN M. HENDRICKX

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

*Julien:* I studied mathematical engineering, a degree at UCLouvain that covers systems and control, optimization, numerical algorithms, and, nowadays, data analysis. I had the opportunity to do my master's thesis on numerical methods for fracture propagation in the Aerospace Department at the University of Illinois. It was during this time that I realized that I really wanted to pursue a research career, and the questions that interested me most were all about dynamical effects. Since I was also very interested in graphs and networks, I started a Ph.D. program in multiagent systems with Vincent Blondel (who later became rector of the university).

The very first seminar of my Ph.D. program was given by Brian D.O. Anderson on the topic of formation control. This immediately caught my interest, and I began thinking about some of the problems he mentioned. Two days later, we started collaborating on a topic that played an important role in my thesis. The next year, I also had the chance to meet John Tsitsiklis, and we started collaborating on opinion dynamics (and several other topics later) during my postdoc with him at the Massachusetts Institute of Technology.

**Q.** What are some of your research interests?

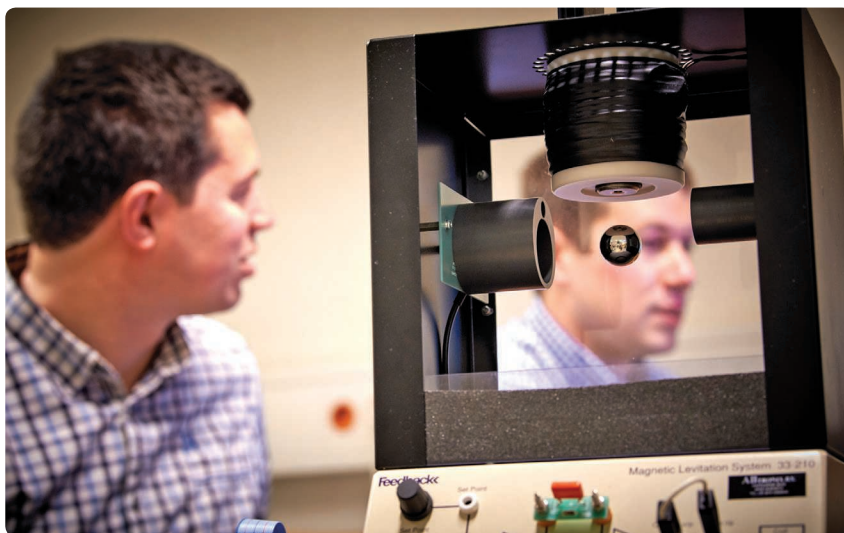
*Julien:* Most of my research interests involve networks: decentralized control laws and algorithms, including decentralized optimization, analyzing multiagent systems, the identification of networked dynamical systems and their structure, or learning problems where the data involved present some network structure. I have also recently worked on quantifying the re-identification risk in anonymized data sets

and computer-aided design tools for optimization algorithms, relying on methods that automatically compute their worst-case performances.

One of my current research projects is related to open networked systems whose composition varies over time. It's full of exciting challenges because many of the classical tools and results no longer apply. In another project, called Revealflight, we take a control approach to the analysis of bird formation flights, in collaboration with colleagues in fluid dynamics and biorobotics. I particularly enjoy this multidisciplinary aspect, and we learn a lot from each other.

**Q.** What courses do you teach relating to control? How would you describe your teaching style?

*Julien:* I teach System Identification, a class called Advanced Control, and design projects in mathematical engineering, which are control oriented every other year. I would describe myself as an experimentalist in terms of teaching methods. As I'm probably biased as a member of the control field, I see teaching as an optimal control problem where we aim to maximize what students learn and understand under a constraint on the time available for everyone. Hence, I try to design the most efficient activity for each topic



Julien M. Hendrickx (left) in the automatic control teaching lab at UCLouvain, next to a magnetic levitation control experiment. (Source: UCLouvain/Eric Herchaft.)



Julien M. Hendrickx on Dante's Peak, Death Valley, California, in the summer of 2019.

and skill, being initially agnostic about the kind of method I will use. I teach classical lectures on a whiteboard or with slides and use lab experiments, flipped classrooms, design projects, or sequences of simple problems guiding students through new material.

I experiment a lot, and I found that students are very receptive to pedagogical experimentations when you inform them and are honest about the observations. As in most control problems, measurement and feedback are crucial. We've also developed an automatic control lab in our department with many fun experiments, including drones, magnetic levitation, and double-inverted pendulums.

More anecdotally, whenever possible, I like to initially confuse students by creating small examples or simulations that are completely at odds with their intuition or appear to make no sense at all. I found this to be a very efficient way of motivating them because they really want to understand what is going on in my example.

**Q. What are some of the most promising opportunities you see in the control field?**

**Julien:** Well, I wonder what I'll think of my answer in 10 years. Taking a step back, the development of smart and interconnected devices over the last years and decades has led to multiple opportunities and challenges.

On the one hand, we have 1) unprecedented amounts of computing power, including in places where we would never have imagined it would be available: almost any cheap device could, in principle, be made to solve an optimization problem, 2) unprecedented abilities to measure and act on systems, and 3) huge amounts of data. All of this makes it possible to apply control ideas to many new domains with high potential societal impact.

On the other hand, the interconnection led to a further complexification of many already very complex systems, with multiple decisions being made at



Julien M. Hendrickx (right) and Bahman Gharesifard tasting the alleged best Belgian beer in Groningen at NecSys 2018.

**Profile of Julien M. Hendrickx**

- *Current position:* professor, Department of Mathematical Engineering, Institute for ICT, Electronics, and Applied Mathematics, UCLouvain, Belgium.
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- *Notable awards:* European Embedded Control Institute Award (2008); Alcatel-Lucent-Bell Award (2009); Best Paper Award of the *Asian Journal of Control* (2006–2008); outstanding reviewer by *IEEE Transactions in Automatic Control* (2011), *Automatica* (2015–2016), *IEEE Control Systems Letters* (2019).

many levels in a centralized or decentralized way. Some of them can significantly change over time (one of the motivations for our study of open multiagent systems). Additionally, it is not clear that these complex systems and reactions can be approximated by nice models. At the same time, the availability of huge amounts of data creates its own challenges, and the data are not always well structured or quantitative.

Therefore, I think one of the main sets of challenges for the future of control will be to develop ways of exploiting these data and connected sensors and actuators to control these complicated systems. For this purpose, it would be interesting to develop a realistic benchmark for such problems.

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

**Julien:** I enjoy jogging and biking. I usually try to run three or four times a week. Of course, the confinement over the last few weeks makes this more challenging. I read a lot; I also enjoy cooking (with, again, a focus on new experiments with food) and building things when I have enough time (I built a playground for my kids). Finally, I love traveling, and being a researcher is a great way to experience many places of the world in a nontourist manner.

**Q. Thank you for your comments.**

**Julien:** Thank you, it was a pleasure and an honor.