In this issue of the *IEEE Control Systems*, we speak with Nicolas Petit, professor and head of the Center Automatique et Systèmes at MINES ParisTech, and James Forbes, associate professor and William Dawson Scholar in the Department of Mechanical Engineering at McGill University.

Nicolas Petit is a professor and the head of the Center Automatique et Systèmes at MINES ParisTech, PSL, in Paris, France. He graduated from Ecole Polytechnique in 1995 and obtained the Ph.D. degree in mathematics and control at Ecole Nationale Supérieure des Mines de Paris in 2000. From 2000 to 2001, he was a postdoctoral scholar in the control and dynamical systems program at the California Institute of Technology. Dr. Petit served as an associate editor for *Automatica* from 2006 to 2015, and he has been senior editor for *Journal of Process Control* since 2014. He has been a scientific advisor for Total since 2000 and a member of the academic senate of IFP Energies Nouvelles since 2014. He is the author of nearly 200 journal and proceedings articles. Dr. Petit has twice received the Journal of Process Control Paper Prize for best article from 2002 to 2005 and 2008 to 2011, and he is also the recipient of the 2016 Production and Operations Regional Award from the Society of Petroleum Engineers. In addition, he received the 2017 Fédération des Industries Électriques, Électroniques de Communication-F2i Award for applied research for his outstanding contribution to Fluigent microfluidic products.

His research interests are in control theory and its application to exoskeletons, refining and energetic processes, multiphase and microfluidic flows, smart ammunitions, and heavy launchers. Several of his works have resulted in large-impact, real-world applications, notably in the fields of commercial fuel blending, unmanned aerial vehicles, automotive aftertreatment systems, and microfluidics. After cofounding a start-up company, he now actively serves on the board or as a scientific advisor for several other start-ups, including Wandercraft, Fieldbox.ai, and K-Ryole. He is a Senior Member of IEEE and AIAA and a member of the Society of Petroleum Engineers.

James R. Forbes is an associate professor and the William Dawson Scholar in the Department of Mechanical Engineering at McGill University. He earned the B.A.Sc. degree in mechanical engineering (honors, co-op) from the University of Waterloo, Ontario, Canada, in 2011. He then completed the M.A.Sc. and Ph.D. degrees in aerospace science and engineering from the University of Toronto Institute for Aerospace Studies, Toronto, Ontario, Canada, in 2008 and 2011, respectively. At McGill, he is an associate member of the Center for Intelligent Machines (www.cim.mcgill.ca/), which is McGill's flagship robotics center. Dr. Forbes is also a member of the Group for Research in Decision Analysis (www.gerad.ca/en/), a multiuniversity research center focused on mathematics applied to decision making. He has conducted and is currently conducting guidance, navigation, and control research in collaboration with multiple industrial partners in various domains, including aerospace engineering, rail transportation, underwater navigation, animation, and automated manufacturing. In 2019, he consulted with the Samsung Artificial Intelligence Center in Montréal. He has coauthored more than 130 refereed conference and journal papers and one textbook and has given many research talks at universities, government research centers, and companies. He enjoys teaching dynamics, control, and state estimation classes at the undergraduate and graduate levels and has won multiple teaching awards. Dr. Forbes leads the Dynamics Estimation and Control of Aerospace and Robotic Systems Group (www.decar.ca/), which includes students and collaborators who conduct research primarily focused on dynamics, state estimation, and control of aerospace and robotic systems.

Rodolphe Sepulchre

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NICOLAS PETIT

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

Nicolas: Early on as a kid, I always had a strong desire to build robots. As I realized during my studies at Ecole Polytechnique, where I started the robotics club with a few friends in 1994, there were interesting and difficult mathematical questions to solve in this field. I learned a lot during my Ph.D. degree under the supervision of Pierre Rouchon, with whom I have shared a strong interest in applied problems. My postdoctoral experience with Richard Murray at CalTech has given me energy that I still feel today and sustained my commitment to work on innovative projects. Many other people have also played an important role. I should at least mention Bill Dunbar, Mark Milam, Laurent Praly, and Miroslav Krstic.

Q. What are some of your research interests?

Nicolas: Roughly speaking, anything that can be used to solve real-world problems is of interest to me: optimal control, predictors for uncertain delay systems, boundary control of fluidics and microfluidics systems, and inertial sensor fusion and control for flexible mechanical systems and high-performance aerial vehicles.

Q. What courses do you teach relating to control? Do you have a favorite course? How would you describe your teaching style?

Nicolas: For more than 10 years, I have been teaching a very general course on automatic control at MINES ParisTech. The idea is to use the solid mathematical background of our undergrads and show them it is instrumental in solving real-world problems for dynamical systems. I think the course has been successful in convincing students that automatic control is a rich and useful subject worthy of effort. Several students who attended the course have been very active in this field.

Nicolas Petit next to a K-Ryole 5, a smart electric trailer allowing bikers to effortlessly transport up to 350 kg, for which he designed the embedded control algorithms. As of August 2020, independent delivery companies operate more than 100 of these trailers daily in Paris.

Nicolas Petit (center) receiving the 2017 Fédération des Industries Électriques, Électroniques de Communication-F2i Award for his outstanding contribution to Fluigent microfluidic products, with (right) Fluigent CEO France Hamber (holding a Flow EZ pressure pump) and Axon' Cable CEO Joseph Puzo.

A great doctoral defense (the first with the Wandercraft team) with (from left) Laurent Praly, Nicolas Petit, Sylvain Finet, Matthieu Masselin, and Alexandre Boulanger from Wandercraft.

I hope this will encourage new talents to study automatic control theory, a central scientific topic that is definitely worthy of effort in the age of startup companies.

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

***Nicolas*:** Of course, I should mention the breakthroughs that quantum control and synthetic biology seem to represent today. However, I am not competent to discuss these topics, even if I feel very proud that our laboratory, the more than 50-year-old Center Automatique et Systèmes, has had a pioneer role in quantum control (as highlighted by the two European Research Council grants that we recently received). It may seem naive, but I think that the vision of cybernetics pioneers (such as Norbert Wiener) is finally being realized. I think we are finally reaching the point when sensors and actuators will be embedded in many smart objects at many geometrical and complexity scales: not only cars and unmanned aerial vehicles but all sorts of objects, such as surgical tools, construction tools, syringe pumps, DNA readers, lab-on-chips, prostheses, irrigation systems, outdoor lighting, agriculture, and wheeled vehicles. I am not talking about prototypes or proofs of concept, but real products bringing improved quality of service and reducing discarded production (a key factor for sustainability).

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

***Nicolas*:** After years of collecting all sorts of man-made objects, sometimes just for the love of engineering, I like to study fine arts and the political history of the 20th century. Listening to good music with family is good, too.

Q. Thank you for your comments.

***Nicolas*:** It has been a pleasure. I hope this will encourage new talents to study automatic control theory, a central scientific topic that is definitely worthy of effort in the age of startup companies.

Profile of Nicolas Petit

- *Current position*: professor, head of Centre Automatique et Systèmes, MINES ParisTech, PSL.
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- *Notable awards*: Production and Operations Regional Award, Society of Petroleum Engineers (2016); FIEEC-F2i award for Applied Research (2017); Journal of Process Control Paper Prize for Best Article (2002–2005), (2008–2011).

JAMES RICHARD FORBES

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

***James*:** I chose to attend the University of Waterloo to study mechanical engineering because of the co-op education program. Out of six co-op placements in industry, each four months long, I did three co-op placements at companies that build automation equipment. My experience designing automation equipment as a co-op student motivated me to do a master's degree to equip myself with more advanced analysis tools. Because of my co-op experience, at the start of my master's degree at the University of Toronto, I was initially more interested in dynamics than control. However, through research and coursework, I quickly began to appreciate the synergy between dynamics and control. Sure, deriving the equations of motion (that is, the dynamics) of a mechanical or aerospace system was fun and interesting. However, then using linear systems theory, Lyapunov stability theory, passive systems theory, or any one of the many other control tools I learned during my master's degree to analyze the system and design a controller to get that mechanical or aerospace system to *do something* was even more fun and interesting! As such, the study of dynamics is what actually led

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