Data-Driven Control: Part One of Two

This issue of *IEEE Control Systems* is the first of two special issues devoted to data-driven control. The guest editor for these two issues is Florian Dörfler, and he was helped by our associate editor, Daniel Quevedo. They assembled seven articles

for this special issue, the first four of which appear in the present issue: "Data-Driven Control Based on the Behavioral Approach: From Theory to Applications in Power Systems," by Ivan Markovsky, Linbin Huang, and Florian Dörfler [A1]; "Kernel Methods and Gaussian Processes for System Identification and Control: A Road Map on Regularized Kernel-Based

Learning for Control," by Algo Carè, Ruggero Carli, Alberto Dalla Libera, Diego Romeres, and Gianluigi Pillonetto [A2]; "Quasi-Stochastic Approximation: Design Principles With Applications to Extremum Seeking Control," by Caio Kalil Lauand and Sean Meyn [A3]; and "Data-Driven Safety Filters: Hamilton-Jacobi Reachability, Control Barrier Functions, and

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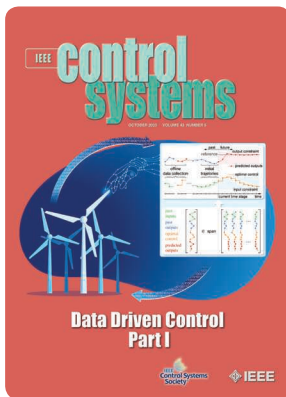

Alberto Dalla Libera

Diego Romeres

Gianluigi Pillonetto

Predictive Methods for Uncertain Systems," by Kim P. Wabersich, Andrew J. Taylor, Jason J. Choi, Koushil Sreenath, Claire J. Tomlin, Aaron D. Ames, and Melanie N. Zeilinger [A4]. The four articles are described in the introductory article by Guest Editor Florian Dörfler [A5].

The "From the Editor" column [A6] presents "Driven by Data," a personal reflection on the current resurgence of interest in data-driven control. In his "President's Message," Magnus Egerstedt [A7] invites Anuradha Annaswamy, past president of the IEEE Control Systems Society (CSS), to share her experience on "The Empower a Billion Lives Competition on Low-Cost Energy Access."

"People in Control" [A8], [A9], [A10], [A11] includes interviews with Lanlan Su, a lecturer in the Department of Automatic Control and Systems Engineering, University of Sheffield, U.K.; Shun-Ichi Azuma, a professor at Kyoto University, Japan; and Christoforos (Chris) N. Hadjicostis, a professor of electrical and computer engineering at the University of Cyprus. "Ph.D.s in Control" [A12] includes an interview with Chao Chen, a postdoctoral researcher at the Hong Kong University of Science and Technology, and Iury Bessa [A13], an assistant professor at the Department of Electricity at the Federal University of Amazonas (UFAM), Brazil. "Institutes in Control" [A14] features the Swiss National Centre of Competence in Research "Dependable Ubiquitous Automation."

"Technical Activities" [A15], [A16] provides an update from Jeff Scruggs on the IEEE CSS Technical Committee on Power Generation and from Majid Zamani on the IEEE CSS Technical Committee on Hybrid Systems. The "25 Years Ago" column [A17] revisits "Control of Diesel Engines," by

Caio Kalil Lauand at the Cummer Museum of Arts and Gardens, Jacksonville, FL, USA.

Aaron Ames in the Robotics Lab, Caltech.

Jason Choi

Claire Tomlin

Koushil Sreenath

Kim Wabersich next to a research vehicle.

L. Guzzella and A. Amstutz. "Conference Calendar" [A18] lists upcoming conferences sponsored or cosponsored by the CSS. "Bookshelf" [A19] provides a discussion by Bozenna Pasik-Duncan of the book *Mathematics and Tools for Financial Engineering* by Petros A. Ioannou. The "Book Announcements" column [A20] provides summaries of books recently published in the control field.

Rodolphe Sepulchre (ID)

APPENDIX: RELATED ARTICLES

[A1] I. Markovsky, L. Huang, and F. Dörfler, "Data-driven control based on the behavioral approach: From theory to applications in power systems," *IEEE Control Syst.*, vol. 43, no. 5, pp. 28–68, Oct. 2023, doi: 10.1109/MCS.2023.3291638.

[A2] A. Carè, R. Carli, A. D. Libera, D. Romeres, and G. Pillonetto, "Kernel methods and Gaussian processes for system identification and control: A road map on regularized kernel-based learning for control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 69–110, Oct. 2023, doi: 10.1109/MCS.2023.3291625.

[A3] C. Kalil Lauand and S. Meyn, "Quasi-stochastic approximation: Design principles with applications to extremum seeking control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 111–136, Oct. 2023, doi: 10.1109/MCS.2023.3291884.

[A4] K. P. Wabersich et al., "Data-driven safety filters: Hamilton-Jacobi reachability, control barrier functions, and predictive methods for uncertain systems," *IEEE Control Syst.*, vol. 43, no. 5, pp. 137–177, Oct. 2023, doi: 10.1109/MCS.2023.3291885.

[A5] F. Dörfler, "Data-driven control: Part one of two: A special issue sampling from a vast and dynamic landscape [From the Editor]," *IEEE Control Syst.*, vol. 43, no. 5, pp. 24–27, Oct. 2023, doi: 10.1109/MCS.2023.3291624.

[A6] R. Sepulchre, "Driven by data [From the Editor]," *IEEE Control Syst.*, vol. 43, no. 5, p. 3, Oct. 2023, doi: 10.1109/MCS.2023.3291608.

[A7] M. Egerstedt, "Controls as a force for good [President's Message]," *IEEE Control Syst.*, vol. 43,

Andrew Taylor hiking into the Grand Canyon.

Melanie Zeilinger

Sean Meyn at the La Chua Trail, Gainesville, FL, USA.

no. 5, pp. 8–10, Oct. 2023, doi: 10.1109/MCS.2023.3291609.

[A8] R. Sepulchre, "People in control," *IEEE Control Syst.*, vol. 43, no. 5, p. 17, Oct. 2023, doi: 10.1109/MCS.2023.3291632.

[A9] L. Su, "People in control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 18–19, Oct. 2023, doi: 10.1109/MCS.2023.3291633.

[A10] S.-I. Azuma, "People in control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 19–21, Oct. 2023, doi: 10.1109/MCS.2023.3291634.

[A11] C. N. Hadjicostis, "People in control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 22–23, Oct. 2023, doi: 10.1109/MCS.2023.3291623.

[A12] C. Chen, "Ph.D.s in control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 178–180, Oct. 2023, doi: 10.1109/MCS.2023.3291899.

[A13] I. Bessa, "Ph.D.s. in control," *IEEE Control Syst.*, vol. 43, no. 5, pp. 181–184, Oct. 2023, doi: 10.1109/MCS.2023.3291910.

[A14] E. Cahard, F. Dörfler, J. Lygeros, and L. Seward, "NCCR automation in Switzerland [Institutes in Control]," *IEEE Control Syst.*, vol. 43, no. 5, pp. 186–190, Oct. 2023, doi: 10.1109/MCS.2023.3291911.

[A15] J. Scruggs, "Technical committee on power generation—May 2023 report [Technical Activities]," *IEEE Control Syst.*, vol. 43, no. 5, pp. 14–15, Oct. 2023, doi: 10.1109/MCS.2023.3291630.

[A16] M. Zamani, "Technical committee on hybrid systems [Technical Activities]," *IEEE Control Syst.*, vol. 43, no. 5, pp. 15–16, Oct. 2023, doi: 10.1109/MCS.2023.3291631.

[A17] L. Guzzella and A. Amstutz, "Control of diesel engines [25 Years Ago]," *IEEE Control Syst.*, vol. 43, no. 5, p. 11, Oct. 2023, doi: 10.1109/MCS.2023.3291629.

[A18] "Conference calendar," *IEEE Control Syst.*, vol. 43, no. 5, p. 195, Oct. 2023, doi: 10.1109/MCS.2023.3291929.

[A19] B. Pasik-Duncan, "Mathematics and tools for financial engineering [Bookshelf]," *IEEE Control Syst.*, vol. 43, no. 5, p. 191, Oct. 2023, doi: 10.1109/MCS.2023.3291912.

[A20] "Book announcements [Bookshelf]," *IEEE Control Syst.*, vol. 43, no. 5, p. 192, Oct. 2023, doi: 10.1109/MCS.2023.3291913.