

Control Challenges for Soft Robotics

This issue of *IEEE Control Systems* is devoted to soft robotics. The guest editor for this special issue is Helmut Hauser. He has assembled four articles for this special issue: see [A1], by Cosimo Della Santina, Christian Duriez, and Daniela Rus; [A2], by Concepcion A. Monje, Bastian Deutschmann,

Magnus Ergstedt introduces the notion of “inreach” as a companion to the established notion of “outreach” and the relevance of this dichotomy for the IEEE CSS.

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Contributors



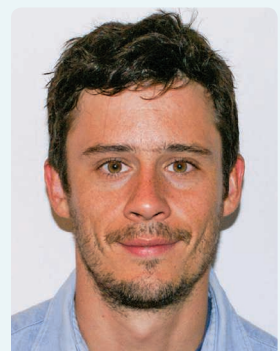
Cosimo Della Santina



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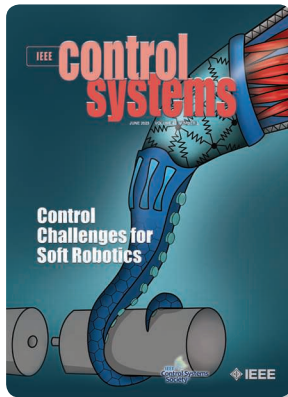


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Jorge Muñoz, Christian Ott, and Carlos Balaguer; [A3], by Cecilia Laschi, Thomas George Thuruthel, Fumiya Iida, Rochdi Merzouki, and Egidio Falotico; and [A4], by Helmut Hauser, Trishantha Nanayakkara, and Fulvio Fornì. The four articles are described in the introductory article by Guest Editor Helmut Hauser [A5].

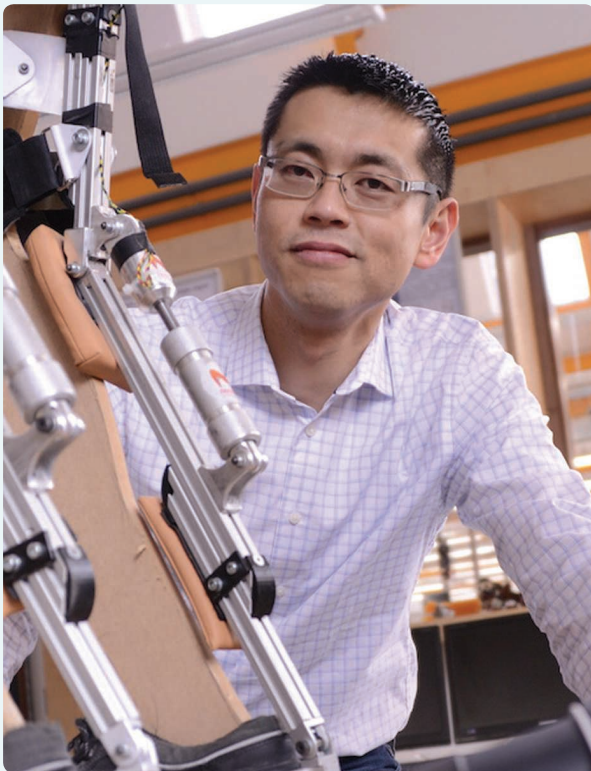


The “From the Editor” column [A6] reflects the growing use of “safety” and “resilience” in the control community and how those new keywords differ from our classical keywords of “performance” and “robustness.” In his “President’s Message” [A7], Magnus

ergstedt (series editor of the IEEE Press Series on Control Systems Theory and Applications) share their thoughts on the book program and how it can benefit prospective authors and Society members alike. “People in Control” [A9]–[A12] includes interviews with Meeko

Oishi (professor and Regents’ Lecturer at the University of New Mexico), Niklas Karlsson (senior principal research scientist at Amazon), and Hector Ramirez (assistant professor at the Universidad Técnica Federico Santa María in Chile). “Ph.D.s in Control” [A13]–[A15] includes an interview with Anastasia Bizyaeva (postdoctoral researcher at Washington University, Seattle), and Jeremy Coulson (assistant professor at the University of Wisconsin–Madison). “Institutes in Control” [A16] features the Department of Automatic Control at Lund University, Sweden. “Technical Activities” [A17], [A18] provides an update from Andrea Serrani on the IEEE Technical Committee on Non-linear Systems and Control and from Christopher Edwards on the IEEE Technical Committee on Variable Structure

ergstedt introduces the notion of “in-reach” as a companion to the established notion of “outreach” and the relevance of this dichotomy for the IEEE Control Systems Society (CSS). In “CSS News” [A8] Dr. Sarah Spurgeon (current editor-in-chief of IEEE Press) and Dr. Maria Di Benedetto (series editor of the IEEE Press Series on Control Systems Theory and Applications) share their thoughts on the book program and how it can benefit prospective authors and Society members alike. “People in Control” [A9]–[A12] includes interviews with Meeko



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and Sliding Mode Control. “CSS Business” [A19], [A20] includes the minutes and consent agenda of the CSS Board of Governors meeting held on 5 December 2022 in Cancun, Mexico. The “25 Years Ago” column [A21] revisits “Interactive Tools for Education in Automatic Control,” by M. Johansson, M. Gafvert, and K.J. Astrom. “Conference Calendar” [A22] lists upcoming conferences sponsored or cosponsored by the IEEE CSS. “Bookshelf” [A23] provides a discussion by Janis Chodas of the book *Six Degrees of Freedom: Opportunities Met, Risks Taken, Lessons Learned*, authored by Peter C. Hughes. “Book Announcements” [A24] provides summaries of books recently published in the control field.

Rodolphe Sepulchre 

APPENDIX: RELATED ARTICLES

[A1] C. Della Santina, C. Duriez, and D. Rus, “Model based control of soft robots: A survey of the state of the art and open challenges,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 30–65, Jun. 2023, doi: 10.1109/MCS.2023.3253419.

[A2] C. A. Monje, B. Deutschmann, J. Muñoz, C. Ott, and C. Balaguer, “Fractional order control of continuum soft robots: Combining decoupled/reduced dynamics models and robust fractional order controllers for complex soft robot

motions,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 66–99, Jun. 2023, doi: 10.1109/MCS.2023.3253420.

[A3] C. Laschi, T. G. Thuruthel, F. Iida, R. Merzouki, and E. Falotico, “Learning-based control strategies for soft robots: Theory, achievements, and future challenges,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 100–113, Jun. 2023, doi: 10.1109/MCS.2023.3253421.

[A4] H. Hauser, T. Nanayakkara, and F. Forni, “Leveraging morphological computation for controlling soft robots: Learning from nature to control soft robots,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 114–128, Jun. 2023, doi: 10.1109/MCS.2023.3253422.

[A5] H. Hauser, “Soft robotics: An introduction to the special issue [Guest Editor Introduction],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 28–29, Jun. 2023, doi: 10.1109/MCS.2023.3253407.

[A6] R. Sepulchre, “Robust performance? Resilient safety! [From the Editor],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 3–4, Jun. 2023, doi: 10.1109/MCS.2023.3253308.

[A7] M. Egerstedt, “From outreach to inreach [President’s Message],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 8–9, Jun. 2023, doi: 10.1109/MCS.2023.3253355.

[A8] “CSS news,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 10–11, Jun. 2023, doi: 10.1109/MCS.2023.3253359.

[A9] R. Sepulchre, “People in control,” *IEEE Control Syst.*, vol. 43, no. 3, p. 19, Jun. 2023, doi: 10.1109/MCS.2023.3253403.

[A10] M. Oishi, “People in control,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 20–21, Jun. 2023, doi: 10.1109/MCS.2023.3253404.

[A11] N. Karlsson, “People in control,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 22–25, Jun. 2023, doi: 10.1109/MCS.2023.3253405.

[A12] H. Ramirez, “People in control,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 25–27, Jun. 2023, doi: 10.1109/MCS.2023.3253406.

[A13] R. Sepulchre, “Ph.D.s. in control,” *IEEE Control Syst.*, vol. 43, no. 3, p. 130, Jun. 2023, doi: 10.1109/MCS.2023.3253423.

[A14] A. Bizyaeva, “Ph.D.s. in control,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 130–132, Jun. 2023, doi: 10.1109/MCS.2023.3253439.

[A15] J. Coulson, “Ph.D.s. in control,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 132–134, Jun. 2023, doi: 10.1109/MCS.2023.3253440.

[A16] R. Banavar, “Department of automatic control at Lund University, Sweden [Institutes in Control],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 135–137, Jun. 2023, doi: 10.1109/MCS.2023.3253441.

[A17] A. Serrani, “Technical committee on nonlinear systems and control [Technical Activities],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 17–18, Jun. 2023, doi: 10.1109/MCS.2023.3253401.

[A18] A. Levant, “Technical committee on variable structure and sliding mode control [Technical Activities],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 16–17, Jun. 2023, doi: 10.1109/MCS.2023.3253402.

[A19] “IEEE CSS board of governors meeting December 5, 2022: Motions for 2023 appointments prepared by Magnus Egerstedt [CSS Business],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 150–153, Jun. 2023, doi: 10.1109/MCS.2023.3254831.

[A20] “Minutes of the control systems society board of governors meeting December 5th, 2022 Cancun, Mexico [CSS Business],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 144–149, Jun. 2023, doi: 10.1109/MCS.2023.3256179.

[A21] M. Johansson, M. Gafvert, and K. J. Astrom, “Interactive tools for education in automatic control [25 Years Ago],” *IEEE Control Syst.*, vol. 43, no. 3, pp. 12–14, Jun. 2023, doi: 10.1109/MCS.2023.3253399.

[A22] “Conference calendar,” *IEEE Control Syst.*, vol. 43, no. 3, p. 143, Jun. 2023, doi: 10.1109/MCS.2023.3254830.

[A23] J. Chodas, “Bookshelf,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 138–140, Jun. 2023, doi: 10.1109/MCS.2023.3254819.

[A24] “Book announcements,” *IEEE Control Syst.*, vol. 43, no. 3, pp. 141–142, Jun. 2023, doi: 10.1109/MCS.2023.3254829.

