# lEEE Technical Committee on Nonlinear Systems and Control

Nonlinear systems cover a wide variety of applications where innovative and advanced nonlinear control algorithms are designed and used. Theoretical advances continue to lead the way as new ideas and approaches combining physics-based and data-driven models are tested and verified on nonlinear systems while accounting for practical constraints on sensors, actuators and processors for real-time control. These advances continue to improve the state-of-the-art in autonomy, cooperative control, adaptation, robustness, time delay systems, and learning-based control.

## MEMBERSHIP AND VISION

The IEEE CSS Technical Committee on Nonlinear Systems and Control (TCNSC) aims to advance the development of nonlinear systems and control theory and promote its practical applications. The technical committee is also responsible for coordination and organization of activities sponsored by the IEEE CSS in the field of nonlinear systems and control. TCNSC membership consists of IEEE Control System Society (CSS) members mainly from academia and government laboratories and some from industry, working on various aspects of nonlinear systems and their applications. The TC also liaisons with the IFAC TC on Nonlinear Control Systems, with which it has several common members and jointly organizes workshops and invited sessions at conferences. TCNSC membership currently stands at 65 members of the IEEE, including two members in the CSS Board of Governors. The TC is currently seeking to expand its membership among young professionals and industry members and has added four new members in 2026.

## TC ORIGINS AND EXPERTISE

The TC was conceived in year 2000 and constituted in 2001, with its first meeting at the American Control Conference in 2001. The first TC Chair was Andrew Teel (University of California, Santa Barbara) and Rodolphe Sepulchre (University of Cambridge, UK) was the first Vice Chair. The founders drew inspiration from the Technical Committee on Nonlinear Systems of the International Federation of Automatic Control (IFAC), which helps organize the IFAC Symposium on Nonlinear Control Systems (NOLCOS). About half of the TC members are also members of the IFAC TC on Nonlinear Systems, with which this TC has had strong ties since its inception. Since its inception, the TC has been primarily involved in organizing workshops and invited sessions at IEEE and IFAC conferences. Its members cover a wide range of expertise areas in nonlinear systems and control, including nonlinear modeling and system identification, control of systems governed by partial differential equations, control of linear systems with state and/or input constraints, physics and geometry based control design, nonlinear observer design, numerical behavior of nonlinear systems, differential geometric nonlinear control, nonlinear model predictive control, nonlinear dynamical systems behavior and stability, and nonlinear data-driven control. In the current era of machine learning-based data-enabled and data-driven control schemes that usually do not have any performance guarantees, the need for research expertise on nonlinear control, estimation and identification techniques that provide performance guarantees on stability, robustness and computational efficiency, cannot be over-emphasized. The TC's overall expertise helps research in this direction, particularly in applications where safe and resilient operations are essential, by providing feedback control methods with the prior-mentioned performance guarantees. Developments in theories and methods for data-driven and data- and physics-enabled feedback control schemes, many of which have been developed by TC members, are expected to make a positive impact on safe and resilient operations of autonomous systems.

## SERVICE AND TECHNICAL LEADERSHIP

Members of the Technical Committee on Nonlinear Systems and Control (TCNSC) are involved

in CSS governance and leadership, as well as research innovations in nonlinear control systems. TC members Kenji Fujimoto (Kyoto University, Japan) and Andrea Serrani (University of Bologna, Italy) are in the CSS Board of Governors and Andrea Serrani is the VP of Publication Activities. Christophe Prieur (CNRS, France) is the Chair of the CSS Conference Editorial Board. Dragan Nesic (University of Melbourne, Australia) and Hiroshi Ito (Kyushu Institute of Technology, Japan) are senior editors of the IEEE Transactions on Automatic Control. Christopher Kellet (ResTech, Australia) and Manfredi Maggiore (University of Toronto, Canada) are senior editors of the IEEE Transactions in Control Systems Technology. In addition, several TC members are involved in the editorial board of top journals in control systems, including Automatica and Systems and Control Letters.

## ACTIVITIES OF TC MEMBERS IN NONLINEAR SYSTEMS AND CONTROL

TC member Tiago Roux de Oliveira (State University of Rio de Janeiro, Brazil) organized the **1st Automatic Control Meeting (Control in Rio 2025)** during the CDC in December 2025 in Rio de Janeiro, Brazil. This inaugural edition was celebrating 50 years of the Brazilian Society of Automatics (SBA) and 75 years of the State University of Rio de Janeiro (UERJ). This meeting was held over four days during the period from December 4 to December 15, 2025. It featured an outstanding lineup of invited speakers, including Miroslav Krstic, Tamer Basar, Mario Rotea, Martin Guay, Florian Dorfler, Romeo Ortega, and Emilia Fridman. Group photographs of attendees from each of the four days of this event, are shown in Figures 1 through 4. More information about this event can be found at the following links: https://sites.google.com/eng.uerj.br/controlinrio2025/ and https://tiagoroux.com/automatic-control-meeting-in-rio/

TC chair Amit Sanyal's group at Syracuse University presented results from their recent research on control and estimation for multi-agent rigid body systems (abbreviated MARBS) at the Northeast Robotics Colloquium (NERC) at Cornell University in October 2025 and at the CDC in Rio de Janeiro in December 2025. The control schemes provide robust and stable pose synchronization or other desired relative pose configurations for multi-vehicle teams with undirected communication graphs, where each vehicle is modeled as a rigid body. A journal paper reporting these theoretical advances is being reviewed for the IEEE Transactions on Automatic Control. Another recent theoretical discovery by his research group is smooth state and time-varying feedback control schemes, which can be applied to MARBS with any type of network graph topology, including dynamic networks. In addition, a nonlinear observer was designed for full state estimation of rigid body motion using onboard sensors giving 3D point cloud measurements of the environment. This observer, termed the finite-time stable pose estimator (abbreviated FTS-PE), is Hölder-continuous and finite-time stable, and has been implemented with two types of sensors — a stereo depth camera and a flash Lidar sensor — in indoor and outdoor field tests. Both continuous-time and discrete-time versions of the FTS-PE have been implemented. Theoretical developments leading to the FTS-PE and its implementation were reported in a poster during the 2026 ACC at New Orleans, LA, and a paper to be presented at the CDC in Honolulu, HI, in December 2026. Figure 5 shows a poster highlighting these schemes at the Northeast Robotics Colloquium (NERC) at Cornell University, while Figure 6 presents snapshots from videos showing side-by-side displays of point cloud data and pose estimation errors from the depth camera and flash Lidar sensors. Figure 7 shows the FTS-PE being used during a prescribed (controlled) burn at the Albany Pine Bush area of upstate New York.

# JOINING THE TC ON NONLINEAR SYSTEMS AND CONTROL

**The TC is actively seeking new members, particularly in two categories: new professionals and industry members**. New professionals include senior doctoral students, post-doctoral scholars and new research faculty within the first two years of starting their faculty positions. Industry members in all stages who are active researchers in all areas of nonlinear systems and control, are also welcome to join the TC NSC. The TC has regular annual meetings held during the CDC in December, where complementary lunch is provided. It occasionally meets during the ACC or CCTA depending on logistics and room availability. The TC is currently planning to make the in-person meetings bi-annual, and plans to add an option of teleconferencing for members who cannot attend in person. IEEE CSS members, including student members, are eligible to join the TCNSC via email, or by attending one of our in-person meetings. If you are interested in joining the TC, please email TC Chair Amit Sanyal (aksanyal@syr.edu) or Vice Chair Olugbenga Moses Anubi (anubi@eng.famu.fsu.edu), and visit the TC website (https://www.ieeecss.org/tc/nonlinear-systems-and-control) for more information.

Amit Sanyal

Chair, IEEE CSS TC on Nonlinear Systems and Control (TCNSC)

Figure 1. A group photograph of attendees from the first day of the first Automatic Control Meeting at UERJ, Rio de Janeiro, Brazil, on December 4, 2025. The first day of this workshop, organized by Tiago Roux de Oliveira, featured talks by Romeo Ortega and Gustavo Artur de Andrade.


Figure 2. A group photograph of attendees from the second day of the first Automatic Control Meeting at UERJ, Rio de Janeiro, Brazil, on December 5, 2025. The second day of this workshop, organized by Tiago Roux de Oliveira, featured talks by Florian Dörfler and Antonio Estrada.

Figure 3. A group photograph of attendees from the third day of the first Automatic Control Meeting at UERJ, Rio de Janeiro, Brazil, on December 8, 2025. The third day of this workshop, organized by Tiago Roux de Oliveira, featured talks by Tamer Başar, Miroslav Krstic, Maro Rotea, and Martin Guay.

Figure 4. A group photograph of attendees from the fourth day of the first Automatic Control Meeting at UERJ, Rio de Janeiro, Brazil, on December 15, 2025. The fourth day of this workshop, organized by Tiago Roux de Oliveira, featured a talk by Emilia Fridman.

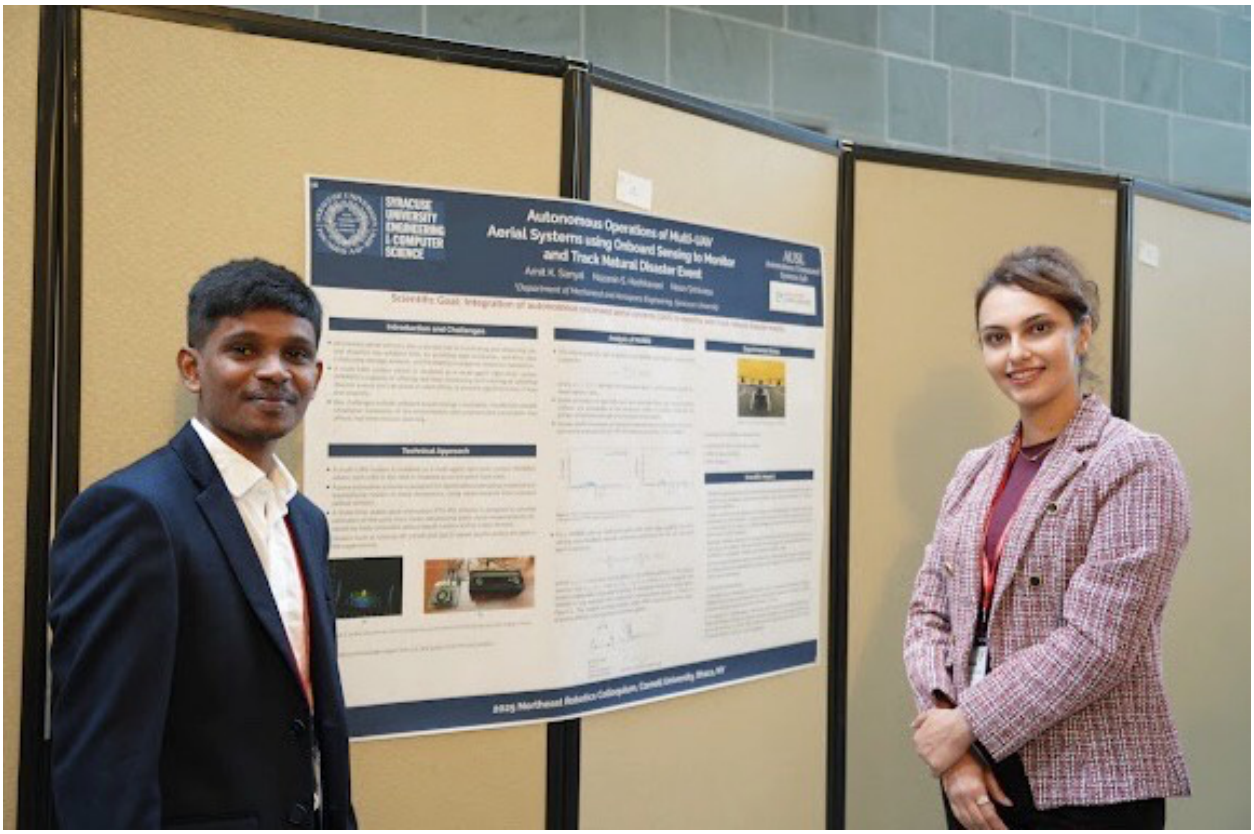


Figure 5. Doctoral students Neon Srinivasu (left) and Nazanin S. Hashkavaei (right) in Amit Sanyal's research group, presenting their poster at the Northeast Robotics Colloquium (NERC) at Cornell University in October 2025.

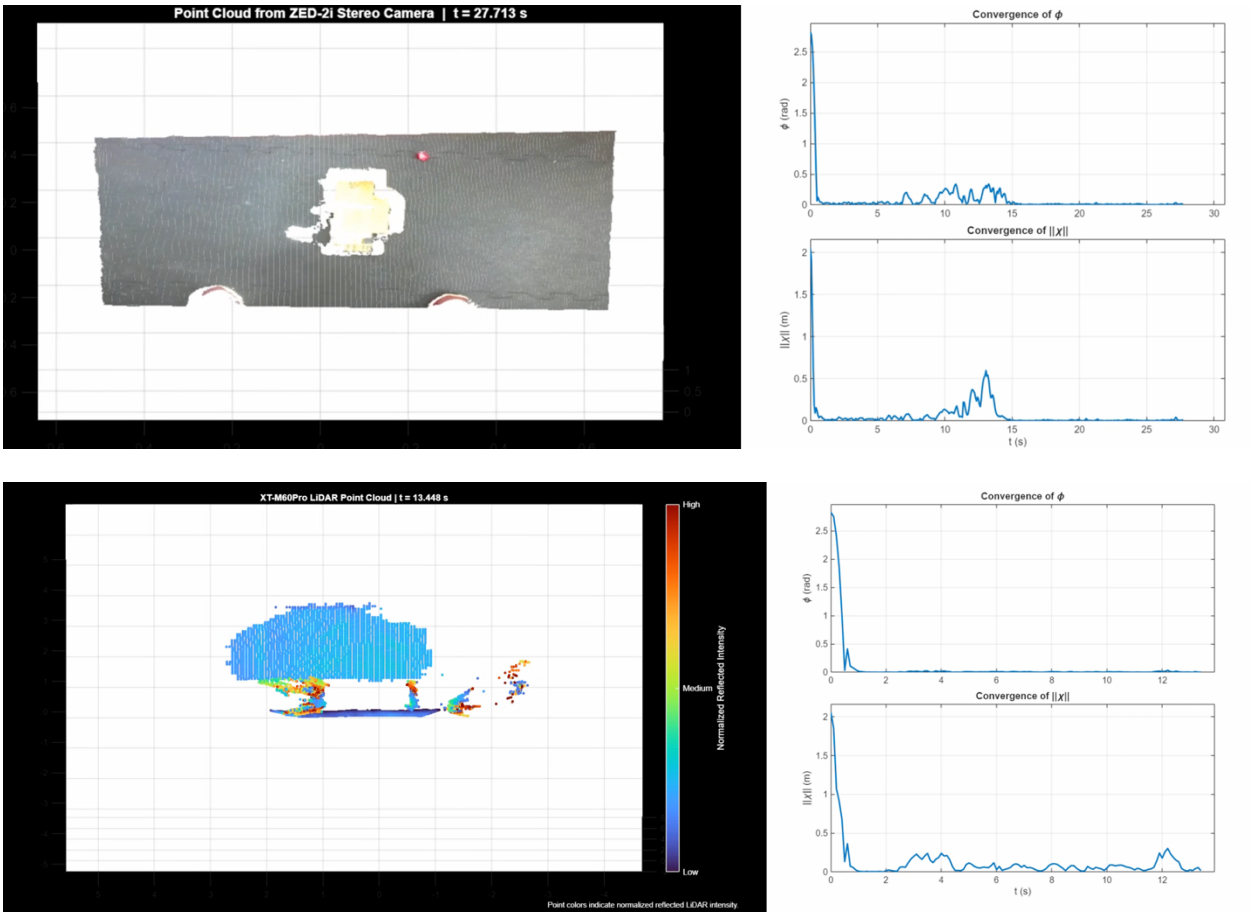


Figure 6. Stills of videos from the finite-time stable pose estimator (FTS-PE), a nonlinear equivariant observer designed to estimate rigid body motion states, being implemented on point cloud data from the ZED 2i stereo depth camera (top) and the XTM60-Pro solid state flash Lidar sensor (bottom). Point cloud data are shown on the left with synchronized time plots showing the evolution of position and orientation estimation errors on the right.


Figure 7. Doctoral student Neon Srinivasu (standing) and undergraduate student Matthew Gwilt (sitting) are gathering data from active fire regions during a prescribed burn on June 3, 2026, at the Albany Pine Bush Preserve in upstate NY. The FTS-PE observer is run on an nVidia Jetson Orin Nano GPU, using vision and IR data from the ZED 2i stereo depth camera to locate and distinguish active fire regions from burnt regions in the undergrowth.