# Dr. Chayan Bhawal

## Personal Data


| | |
|---|---|
| Address: | Indian Institute of Technology Guwahati.<br>Room - 213, New Extension Block, EEE Department. |
| Phone: | +91 361 258 2511 |
| email: | bhawal@iitg.ac.in, chayanbhawal.phd@gmail.com |
| Webpage: | chayanbhawal.github.io |


## Work Experience

| | |
|---|---|
| Jan 2020 - Ongoing | Assistant Professor,<br>Electronics and Electrical Department,<br>Indian Institute of Technology Guwahati. |
| Jun 2019 - Dec 2019 | Post-doctoral Research Fellow<br>Max Planck Institute for Dynamics of Complex Technical Systems,<br>Computational Methods in Systems and Control theory, Magdeburg. |
| Oct 2010 - Jun 2013 | Assistant Professor, Electronics and Communication Engineering,<br>NETES Institute of Technology & Science Mirza (NITSM), Assam. |
| Jul 2008 - Sep 2010 | Executive in Network Operations Department,<br>Vodafone Spacetal Limited, Assam & NE circle. |

## Education

| | |
|---|---|
| 2013 – 2019 | Ph.D. in Electrical Engineering.<br>Indian Institute of Technology Bombay, Mumbai.<br>Specialization – Control and Computing (CGPA – 9.25 out of 10).<br>Thesis title – Generalized Riccati theory: A Hamiltonian system approach. |
| 2004 – 2008 | Bachelor of Engineering.<br>Specialization – Electronics and Telecommunication.<br>Assam Engineering College, Jalukbari.<br>Grade – First class 2nd position with Honours (Percentage – 78.56%). |
| 2002 – 2004 | Higher Secondary Examination (10+2).<br>Cotton College, Guwahati, AHSEC (Percentage – 84.20%). |
| 1990 – 2002 | High School Leaving Certificate.<br>Arunodaya English Medium High School, Mirza, SEBA (Percentage – 83.17%). |

## Publications

### Journal papers: published

1. Ashish Kothyari, Chayan Bhawal, Madhu N Belur, and Debasattam Pal, "Imaginary axis eigenvalues of Hamiltonian matrix: controllability, defectiveness and the epsilon-characteristic", *International Journal of Control*, Accepted (in publication stage), 2022.

2. Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "Closed form solutions of singular KYP lemma: strongly passive systems, and fast lossless trajectories", *International Journal of Control*, vol. 93, no. 5, pages 1204 - 1217, 2020.

3. Chayan Bhawal and Debasattam Pal, "Almost every single-input LQR optimal control problem admits a PD feedback solution", *IEEE Control Systems Letters*, vol. 3, no. 2, pages 452 - 457, 2019.

4. Chayan Bhawal, Imrul Qais, and Debasattam Pal, "Constrained generalized continuous algebraic Riccati equations (CGCAREs) are generically unsolvable", *IEEE Control Systems Letters*, vol. 3, no. 1, pages 192–197, 2019.

5. Chayan Bhawal, Debasattam Pal, Sandeep Kumar, and Madhu N Belur, "New results and techniques for computation of stored energy in lossless/all-pass systems", *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 64, no. 1, pages 72–85, 2017.

### Contributed book chapter

1. Chayan Bhawal, Sandeep Kumar, Debasattam Pal, and Madhu N Belur, " New properties of ARE solutions for strictly dissipative and lossless systems", *Mathematical Control Theory II: Behavioral Systems and Robust Control*, pages 81-99, Springer International Publishing, Cham, 2015.

### Conference papers: peer-reviewed

1. Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "Lossless trajectories of singularly passive systems", *In Proceedings of Mathematical Theory of Networks and Systems (MTNS)*, Bayreuth, Germany, September 12 - September 16, 2022.

2. Imrul Qais, Chayan Bhawal, and Debasattam Pal, "A Hamiltonian system based approach for the computation of the maximal rank-minimizing solution of the LMI arising from a singular LQR problem", *In Proceedings of European Control Conference (ECC)*, London, UK, July 12 - July 15, 2022.

3. Imrul Qais, Debasattam Pal, and Chayan Bhawal, "A geometric characterization of the slow space of the Hamiltonian system arising from the singular LQR problem", *In Proceedings of IFAC World Congress*, Berlin (Virtual mode), Germany, July 12 - July 17, 2020.

4. Chayan Bhawal, Jan Heiland, and Peter Benner, "PD controllers to solve single-input, index-1 DAE based LQR problems", *In Proceedings of European Control Conference (ECC)*, Saint Petersburg, Russia, May 12 - May 15, 2020.

5. Chayan Bhawal, Debasattam Pal, and Madhu N. Belur, "On circulant Lyapunov operators, two-variable polynomials, and DFT", *In Proceedings of Indian Control Conference (ICC)*, Hyderabad, December 18 - December 20, 2019.

6. Chayan Bhawal and Debasattam Pal, "On solvability of CGCARE for LQR problems with zero input-cost", *In Proceedings of IEEE Conference on Decision and Control (CDC)*, Nice, France, December 11 - December 13, 2019.

7. Ashish Kothyari, Chayan Bhawal, Madhu N Belur, and Debasattam Pal, "Defective Hamiltonian matrix imaginary eigenvalues and losslessness", *In Proceedings of Indian Control Conference (ICC)*, Delhi, India, January 9 - January 11, 2019.

8. Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "On solutions of bounded-real LMI for singularly bounded-real systems", *In Proceedings of European Control Conference (ECC)*, Limassol, Cyprus, June 12 - June 15, 2018.

9. Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "On the link between storage functions of allpass systems and Gramians", *In Proceedings of IEEE Conference on Decision and Control (CDC)*, Melbourne, Australia, December 12 - December 15, 2017.

10. Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "A 2D-DFT based method to compute the Bezoutian and a link to Lyapunov equations", *In Proceedings of Indian Control Conference (ICC)*, Guwahati, India, January 4 - January 6, 2017.

11. Sandeep Kumar, Chayan Bhawal, Debasattam Pal, and Madhu N Belur, "New results and algorithms for computing storage functions: The lossless/allpass cases", *In Proceedings of European Control Conference (ECC)*, Aalborg, Denmark, June 29 - July 1, 2016.

## Projects

1. Project Title: Testbed for vision-based control of unmanned vehicles.
   Status: Completed (Aug 2020 - Aug 2022).
   Funding Agency: IIT Guwahati.
   Project cost: Rs. 5 lakhs.

2. Project Title: On feedback controllers for LQR control of multi-input index-1 DAE systems.
   Status: Ongoing (Dec 2021 - Dec 2023).
   Funding Agency: SERB (Start-up Grant).
   Project Cost: Rs. 6.82 lakhs.

## Workshops/Sessions conducted

- Conducted course on "Advanced Engineering Mathematics (EE5108Z)" online at University of CapeTown, South Africa, Mar - Apr 2022.
- Delivered lectures as part of "Online FDP on Numerical & Engineering Computation, Optimization for Physicists, Scientists & Engineers - SCILAB" program organized by EICT Academy, Feb - Mar 2022.
- Delivered an invited lecture (online) titled "Introduction to Optimal Control" in TEQIP (III) sponsored online Short Term Course on "Advances in Control Systems Engineering and Applications (ACSEA 2020)" organized by Department of Electrical Engineering, SVNIT Surat, Sep 2020.
- Basics of Scilab, Dr. Ambedkar Institute of Technology, Bangalore under TEQIP, 2018.
- Robotics using AVR and PIC Microcontrollers, NITSM Labs, Guwahati and Bangalore, 2011.

## Awards and Other professional activities

- *Excellence in Ph.D. Research Award* for the year 2018-2020 by IIT Bombay.
- *Reviewer* for IEEE Transactions on Circuits and Systems-I: Regular Papers, IEEE Transactions on Automatic Control, Automatica, Robotica, Sadhana, IFAC ACODS, IEEE Indian Control Conference.
- Member of publication committee in IFAC ACODS 2022.