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EDUCATION

Ph.D.	Indian Institute of Technology Bombay	**9.83 (out of 10) CPI**	2012
M.Tech.	Indian Institute of Technology Bombay	**10 (out of 10) CPI**	2007
B.E.E	Jadavpur University	**84.9 %**	2005.

EXPERIENCE

Assistant Professor	I.I.T. Guwahati Guwahati, India	July, 2012 - May, 2014
Assistant Professor	I.I.T. Bombay Mumbai, India	June, 2014 - July, 2019
Associate Professor	I.I.T. Bombay Mumbai, India	August, 2019 - Present

EDITORIAL RESPONSIBILITIES

1. Associate Editor: Mathematics of Control, Signals and Systems (MCSS).
2. Associate Editor: 6th, 7th, 8th Indian Control Conference (ICC).
3. Associate Editor: 8th IFAC Symposium on System Structure and Control (SSSC).

Courses taught:

- **(As instructor)**
  - Estimation and identification,
  - Behavioural theory of systems,
  - Applied linear algebra,
  - Matrix computations,
  - Mathematical analysis in engineering,
  - Linear systems theory,
  - Nonlinear systems and control,
  - Applied control lab.
- **(As course associate)**
  - EE101 Basic electronics and electrical engineering,
  - EE220 Signals and systems.
- **(As a part of CEP/QIP)**
  - Linear algebra with applications to systems and control theory (at CEP, IIT Bombay),
  - Mathematics of control theory (at CEP, IIT Bombay),
  - Numerical linear algebra and its applications (at TEQIP, Nanded),
  - Robo-dynamics: theory and practice (at Bharat Electronics Ltd - BEL, Bengaluru),
  - Dynamics and control of autonomous vehicles (at Bharat Electronics Ltd - BEL, Bengaluru),
  - Solving differential equations using commutative algebra (at TEQIP, IIT Bombay),
  - Algebraic analysis of multi-dimensional systems (at IIT Kharagpur).

PUBLICATIONS

Journal (appeared/accepted)

1. I. Qais and **D. Pal**, The continuous-time singular LQR problem and the riddle of non-autonomous Hamiltonian Systems: a behavioral solution. Accepted for publication in *IEEE Transactions on Automatic Control*, 2022.
2. **D. Pal** and S. Shankar, The coarsest lattice that determines a discrete multidimensional system. Accepted for publication in *Mathematics of Control, Signals and Systems*, 2022.
3. N. Pandey, **D. Pal**, D. Saha, and S. Ganguly. Vibration based biomimetic odour classification. *Nature Scientific Reports*, 11:1, 1-8, 2021.
4. M. Mukherjee and **D. Pal**. On minimality of initial data required to solve an overdetrmined system of partial difference equations. *SIAM Journal on Control and Optimization*, 59:2, 1520-1554, 2021.
5. C.D. Athalye, **D. Pal** and H.K. Pillai. Comparison between different notions of stability for Laurent systems. *IEEE Transactions on Automatic Control*, 66:2, 768-772, 2021.
6. V.S. Sawant, D. Chakraborty and **D. Pal**. Intermittent feedback control with maximum average off-time. *IEEE Transactions on Automatic Control*, 66:10, 5013-5020, 2020.
7. P. Raj and **D. Pal**. Lie algebraic criteria for stability of switched systems of differential algebraic equations (DAEs). *IEEE Control Systems Letters*, 5:4, 1333-1338, 2020.
8. K. Appaiah and **D. Pal**. All-pass filter design using Blaschke interpolation. *IEEE Signal Processing Letters*, 27, 226-230, 2020.
9. C. Bhawal, **D. Pal** and M.N. Belur. Closed form solutions of a singular case of KYP lemma: strongly passive systems, and fast lossless trajectories. *International Journal of Control*, 93:4, 1204-1217, 2020.
10. C.D. Athalye, **D. Pal** and H.K. Pillai. Behavior of n infinite chains of kinematic points with the immediate-neighbors interaction dynamics. *IEEE Transactions on Automatic Control*, 65:7, 2929-2940, 2019.
11. C. Bhawal and **D. Pal**. Almost every single-input LQR optimal control problem admits a PD feedback solution. *IEEE Control Systems Letters*, 3:2, 452-457, 2019.
12. M. Mukherjee and **D. Pal**. On characteristic cones of discrete nD autonomous systems: theory and algorithm. *Multidimensional Systems and Signal Processing*, 30:2, 611-640, 2019.
13. C. Bhawal, I. Qais and **D. Pal**. Constrained generalized continuous algebraic Riccati equations (CGCAREs) are generically unsolvable. *IEEE Control Systems Letters*, 3:1, 192-197, 2018.
14. C.D. Athalye, **D. Pal** and H.K. Pillai. ℓ^2 stability: the cases of infinite dimensional discrete autonomous systems and 2D autonomous systems. *Automatica*, 84, 70-78, 2017.
15. **D. Pal**. Every discrete 2D autonomous system admits a finite union of parallel lines as a characteristic set. *Multidimensional Systems and Signal Processing*, 28:1, 49-73, 2017.
16. S.C. Jugade, **D. Pal**, R.K. Kalaimani and M.N. Belur. Fast modes in the set of minimal dissipation trajectories. *Systems and Control Letters*, 101, 28-36, 2017.
17. C. Bhawal, **D. Pal**, S. Kumar and M.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*, 64:1, 72-85, 2017.
18. **D. Pal** and H.K. Pillai. Multidimensional behaviors: the state-space paradigm. *Systems and Control Letters*, 95, 27-34, 2016.
19. S. Vijayakumaran and **D. Pal** On the minimum redundancy of SEC-DAEC-TAEC binary linear block codes. *IEEE Communication Letters*, 20:4, 652-655, 2016.
20. C.D. Athalye, **D. Pal** and H.K. Pillai. ℓ^∞ stability analysis of discrete autonomous systems described by Laurent polynomial matrix operators. *Systems and Control Letters*, 93, 13-20, 2016.
21. **D. Pal** and H.K. Pillai. Algorithms for the theory of restrictions of scalar nD systems to proper subspaces of $\mathbb{R}^n$. *Multidimensional Systems and Signal Processing*, 26:2, 439-457, 2015.
22. **D. Pal** and H.K. Pillai. On restrictions of nD systems to 1D subspaces. *Multidimensional Systems and Signal Processing*, 25:1,115-144, 2014.

23. **D. Pal** and M.N. Belur. Nyquist plots, finite gain/phase margins and dissipativity. *Systems and Control Letters*, 62, 890-894, 2013.
24. **D. Pal** and H.K. Pillai. Representation formulae for discrete 2D autonomous systems. *SIAM Journal on Control and Optimization*, 51:3, 2406-2441, 2013.
25. **D. Pal** and M.N. Belur. Improper optimal/suboptimal L_∞ control. *IEEE Transactions on Automatic Control*, 57:5, 1280-1285, 2012.
26. **D. Pal** and H.K. Pillai. Lyapunov stability of strongly autonomous nD systems. *International Journal of Control*, 84:11, 1759-1768, 2011.
27. **D. Pal** and M.N. Belur. Dissipativity of uncontrollable systems, storage functions and Lyapunov functions. *SIAM Journal on Control and Optimization*, 47:6, 2930-2966, 2008.

Journal (under review)

1. M. Mukherjee and **D. Pal**. On arbitrary assignability of initial conditions for a discrete autonomous n-D system.
2. D. Gaharwar, K. Appaiah, and **D. Pal**. Design of MIMO All-Pass Filters via Subspace Nevanlinna Interpolation.
3. A. Kothyari, C, Bhawal, M.N. Belur, and **D. Pal**. Imaginary axis eigenvalues of Hamiltonian matrix: controllability, defectiveness and the ϵ-characteristic.
4. C. Bhawal, I. Qais, J. Hailand, and **D. Pal**. The optimal cost of the singular LQR problem, and fast/slow subspaces of the Hamiltonian system. Under review.

Conference

1. I. Qais, C. Bhawal and **D.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 the *European Control Conference (ECC)*, London, UK, 2022.
2. V. Sawant, D. Chakrabortyi, and **D. Pal**. Asynchronous consensus with minimum Communication. In Proceedings of the *24th International Symposium on Mathematical Theory of Networks and Systems (MTNS)*, Cambridge, UK, 2020 (event cancelled due to COVID-19 pandemic).
3. M. Mukherjee and **D. Pal**. On constructing boundaries for boundary value problems defined by over-determined systems of partial differential equations. In Proceedings of the *21st IFAC World Congress (IFAC WC)*, Berlin, Germany, 2020.
4. H. Phani Raj and **D. Pal**. Lie-Algebraic criterion for stability of switched differential-algebraic equations. In Proceedings of the *21st IFAC World Congress (IFAC WC)*, Berlin, Germany, 2020.
5. I. Qais, **D. Pal**, and C. Bhawal . A geometric characterization of the slow space of the Hamiltonian system arising from the singular LQR problem. In Proceedings of the *21st IFAC World Congress (IFAC WC)*, Berlin, Germany, 2020.
6. M. Mukherjee and **D. Pal**. On arbitrary assignability of initial conditions for an overdetermined system of partial difference equations. In Proceedings of the *European Control Conference (ECC)*, St. Petersburg, Russia, 2020.
7. V. Sawant, D. Chakraborty and **D. Pal**. Asynchronous consensus of continuous-time multiagent systems with minimum communication. In Proceedings of the *58th IEEE Conference on Decision and Control (CDC)*, Nise, France, 2019.
8. C. Bhawal and **D. Pal**. On solvability of CGCARE for LQR problems with zero input-cost. In Proceedings of the *58th IEEE Conference on Decision and Control (CDC)*, Nise, France, 2019.
9. C. Bhawal, **D. Pal** and M.N. Belur. On circulant Lyapunov operators, two-variable polynomials, and DFT. In Proceedings of the *Indian Control Conference (ICC)*, Hyderabad, India, 2019.
10. M. Mukherjee and **D. Pal**. Computation of solutions for an overdetermined system of partial difference equations. In Proceedings of the *Indian Control Conference (ICC)*, Hyderabad, India, 2019.

11. A. Kothyari, C. Bhawal, M.N. Belur and **D. Pal**. Defective Hamiltonian matrix imaginary eigenvalues and losslessness, Proceedings of the *5th IEEE Indian Control Conference (ICC)*, Delhi, 2019.
12. C. Bhawal, **D. Pal** and M.N. Belur. On solutions of bounded-real LMI for strongly bounded-real systems. In Proceedings of the *European Control Conference (ECC)*, Limassol, Cyprus, 2018.
13. S. Kumar, M.N. Belur and **D. Pal**. New results and methods in balancing spectral-zero-interpolation based model order reduction. In Proceedings of the *European Control Conference (ECC)*, Limassol, Cyprus, 2018.
14. V. Sawant, D. Chakraborty and **D. Pal**. Intermittent feedback based rejection of persistent bounded disturbance. In Proceedings of the *IEEE American Control Conference (ACC)*, Milwaukee, USA, 2018.
15. C. Bhawal, **D. Pal** and M.N. Belur. On the link between storage functions of allpass systems and gramians. In Proceedings of *the 56th IEEE Conference on Decision and Control (CDC)*, Melbourne, Australia, 2017.
16. I. Qais and **D. Pal**. Stability of interconnection, dissipativity, and mixing". In Proceedings of *the 56th IEEE Conference on Decision and Control (CDC)*, Melbourne, Australia, 2017.
17. M. Mukherjee and **D. Pal**. Algorithms for verification characteristic sets of discrete autonomous nD systems with general $n \geqslant 2$. In Proceedings of *the 20th IFAC World Congress*, Toulouse, France, 2017.
18. S. Kumar, C. Bhawal, **D. Pal** and M.N. Belur. New results and algorithms for computing storage functions: the lossless/all-pass cases. In Proceedings of *the 15th European Control Conference*, Aalborg, Denmark, 2016.
19. C. Bhawal, **D. Pal** and M.N. Belur. A 2D-DFT based method to compute the Bezoutian and a link to Lyapunov equations. In Proceedings of *the 3rd Indian Control Conference*, IIT Guwahati, India, 2017.
20. C.D. Athalye, **D. Pal** and H.K. Pillai. ℓ^∞ stability of N infinite chains of kinematic points. In Proceedings of *the 3rd Indian Control Conference*, IIT Guwahati, India, 2017.
21. M. Mukherjee and **D. Pal**. On characteristic cones of scalar autonomous nD systems, with general n. In Proceedings of *the 22nd International Symposium on Mathematical Theory of Networks and Systems (MTNS)*, Minnesota, 2016.
22. A. Kothyari, C. Praagman, **D. Pal** and M.N. Belur. A subspace intersection based method for faster computation of the storage function for the lossless and allpass cases. In Proceedings of the International Symposium on Mathematical Theory of Networks and Systems (MTNS), Minnesota, USA, July, 2016.
23. C.D. Athalye, **D. Pal** and H.K. Pillai. Stability analysis of discrete 2D autonomous systems. In Proceedings of *the 54th IEEE Conference on Decision and Control (CDC)*, Kyoto, Japan, December, 2015.
24. **D. Pal** and H.K. Pillai. Structural properties of the state space of discrete 2D autonomous systems. In Proceedings of *the 1st Indian Control Conference (ICC)*, IIT Madras, Chennai, January, 2015
25. N.S. Kumar and **D. Pal**. Dissipativity analysis of SISO systems using Nyquist plot compatible supply rates. In *Proceedings of the 53rd IEEE Conference on Decision and Control (CDC)*, Los Angeles, USA, December, 2014.
26. **D. Pal** and H.K. Pillai. Novel representation formulae of discrete 2D autonomous systems. In *Proceedings of the 53rd IEEE Conference on Decision and Control (CDC)*, Los Angeles, USA, December, 2014.
27. S.C. Jugade, **D. Pal**, R.K. Kalaimani and M. N. Belur. Stationary trajectories, singular Hamiltonian systems and ill-posed Interconnection. In *Proceedings of the IEEE European Control Conference (ECC)*, Zurich, Switzerland, 2013.
28. **D. Pal** and H.K. Pillai. An algebraic characterization of free directions of scalar nD autonomous systems. In *Proceedings of the 20th International Symposium on Mathematical Theory of Networks and Systems (MTNS)*, Melbourne, Australia, 2012.

29. **D. Pal** and H.K. Pillai. On restrictions of n-d systems to 1-d subspaces. In *Proceedings of the 7th International Workshop on Multidimensional (nD) Systems (nDS)*, Poitiers, France, 2011.
30. S. Datta, **D. Pal** and D. Chakraborty. Partial pole placement and controller norm optimization over polynomial stability region. In *Proceedings of the 18th IFAC World Congress*, Milan, Italy, 2011.
31. **D. Pal** and M.N. Belur. Finite gain and phase margins as dissipativity conditions. In *Proceedings of the IEEE American Control Conference (ACC)*, Baltimore, USA, 2010.
32. **D. Pal** and M.N. Belur. New results in dissipativity of uncontrollable systems and Lyapunov functions. In *Proceedings of the Joint 48th IEEE Conference on Decision and Control (CDC)*, Shanghai, P.R. China, 2009.
33. **D. Pal**, S. Sinha, M.N. Belur and H.K. Pillai. New results in optimal quadratic supply rates. In *Proceedings of the 47th IEEE Conference on Decision and Control (CDC)*, Cancun, Mexico, 2008.

Book chapters

1. C. Bhawal, S. Kumar, **D. Pal** and M.N. Belur. New properties of ARE solutions for strictly dissipative and lossless systems. In M.N. Belur, M.K. Camlibel, P. Rapisarda and J.M.A. Scherpen (Ed.) *Mathematical Control Theory II: Behavioral Systems and Robust Control, Lecture Notes in Control and Informational Sciences*, Springer, 2015.

RESEARCH INTEREST

- Algebraic analysis of dynamical systesm,
- Computational commutative algebra,
- Systems and control theory,
- Optimal control,
- Distributed parameter/multidimensional systems,
- Consensus in and control of multi-agent systems.

HONORS AND AWARDS

1. Excellence in Teaching Award, EE Department, IIT Bombay, 2021.
2. Science and Engineering Research Board (SERB), Govt. of India, "MATRICS" research grant award, 2020.
3. Department of Science and Technology (DST), Govt. of India, "INSPIRE" faculty scheme award, Phase II, 2014.
4. Award for **Excellence in Ph.D. Thesis Work** for the year 2011-2013, IIT Bombay.
5. Prof G.N. Revankar prize for the **Most Outstanding M.Tech. Student of the Year 2007**, IIT Bombay.
6. Shubha and Anand Talwalkar memorial award for standing **First in M.Tech. in EE Department in the year 2007**, IIT Bombay.
7. University Bronze Medal for standing **First in B.E.E.**, Jadavpur University, 2005.
8. Stood **3rd in West Bengal Higher Secondary** Examination (10+2), 2001.