

LAKSHMAN MAHTO

Assistant Professor

Phone: +91-98820-44168, Email: [lm.iitmandi@gmail.com](mailto:lm.iitmandi@gmail.com)

<https://sites.google.com/view/lakshya/home>

CURRICULUM VITAE

Centre for Quantitative Economics and Data Science

Birla Institute of Technology Mesra, Ranchi

Ranchi-835215, Jharkhand, India

## RESEARCH INTEREST

---

**Dynamical systems & control:** Modelling forced or unforced evolution in a state space & establishing its stability and control. Theoretical & data driven system dynamics in statistical learning framework, computing system dynamics, stability & control to estimate perception, prediction & planning in an autonomous control system.

**Statistical learning:** Designing a predictive function in statistical learning framework with discriminative modelling (e.g. regression) or generative modelling (e.g. multi-modality with CVAE) by minimizing a suitable loss function. Transforming a learning problem as an optimization problem.

**Optimization:** First order & second order adaptive descent algorithms, interior point method for convex problems. Convexification or relaxation or breaking symmetry or introducing uncertainty in non-convex problems & transforming geometrical or physical intuition of the problem into a scalable optimization algorithm.

**With an application of above three to autonomous control systems & data-driven evolutionary processes in science & engineering.**

### 1. Autonomous vehicle as an autonomous control system:



### 2. Learning a nonlinear dynamical system in statistical learning framework that appears in control or physical or biological or social systems.

## ACADEMIC POSITION

---

December 2024 – Present: **Assistant Professor**, Centre for Quantitative Economics and Data Science, Birla Institute of Technology Mesra, Ranchi, India.

December 2021 – December 2024: **Assistant Professor** (Mathematics), Humanities & Science, Indian Institute of Information Technology Dharwad, India.

July 2019 – December 2021: **Assistant Professor (Grade-II, Level-11)** (Mathematics), Humanities & Science, Indian Institute of Information Technology Dharwad, India.

August 2017 – July 2019: **Assistant Professor (Grade-II, Level-10)** (Mathematics), Humanities & Science, Indian Institute of Information Technology Dharwad, India.

August 2016 – August 2017: **Assistant Professor (Contractual)** (Mathematics), Humanities & Science, Indian Institute of Information Technology Dharwad, India.

February 2015 – August 2016: **Postdoctoral Fellow** (Mathematics), The Institute of Mathematical Sciences Chennai, India. Adviser: Dr. S. Kesavan.

## EDUCATION

---

2010–2014: **Doctor of Philosophy** (Mathematics), School of Basic Sciences, Indian Institute of Technology Mandi, India. Course work CGPA: 9.0. Adviser: Dr. Syed Abbas.

2007–2009: **Master of Science** (Mathematics with specialization in operation research), University Department of Mathematics, Ranchi University Ranchi, India. Marks: 57.56%.

2004–2007: **Batchlor of Science** (Mathematics), St. Xavier’s College Ranchi, India. Marks: 63.38%.

2001–2003: **Intermediate Science** (PCM), JC College Dumri, Jharkhand, India. Marks: 65.93%

2000–2001: **Secondary** (All subjects), SSKB High School Dumri, Jharkhand, India. Marks: 60.29%.

## RESEARCH EXPERIENCE

---

February 2015–August 2016: **Postdoctoral Fellow** (Mathematics), The Institute of Mathematical Sciences Chennai, India. Adviser: Dr. S. Kesavan.

September 2014–January 2015: **Project Assistant** (A DST sponsored project on differential equations), School of Basic Science, Indian Institute of Technology Mandi India. Adviser: Dr. Syed Abbas.

February 2010– September 2010: **Senior Research Fellow** (A DST project on statistical techniques), Applied Mathematics, Birla Institute of Technology Mesra, India. Adviser: Dr. Manish Trivedi.

## HONORS AND AWARDS

---

2015–2017: **IMSc Institute Postdoctoral Fellowship** in Mathematics.

2010–2014: **MHRD Doctoral Fellowship** in Mathematics.

2010: Qualified **GATE-2010**

2012: Qualified **CSIR-NET**

## TEACHING EXPERIENCE

---

Dec. 2024–Present: **Assistant Professor**, Centre for Quantitative Economics and Data Science, Birla Institute of Technology Mesra, Ranchi, India.

- a. Advanced optimization: (2025): Stochastic control and dynamic programming, Bellman’s optimality principle for dynamical programming, finite & infinite horizon problems, perfect & imperfect state information, undiscounted & discounted cost functions.

- b. Intermediate analysis: (2025): Sequence & series of functions, Power series & Fourier series, Riemann integrals, Calculus of several variables and multiple integrals.

Aug. 2016– Dec. 2024: **Assistant Professor** (Mathematics), Humanities & Science, Indian Institute of Information Technology Dharwad, India.

**Courses taught:**

- c. Linear models & optimization: (2020, 2021, 2024): Matrix decompositions & kernel embeddings, numerical optimization & statistical estimations, linear models, generalized linear models.
- d. Convex optimization: (2018, 2019, 2020): Convexity of sets & functions, separation oracle & optimality conditions, convex optimization problems & duality, optimization algorithms & statistical estimations.
- e. Probability & statistics: (2018, 2019, 2020, 2021, 2022, 2023): Basic probabilistic modelling, Probability distributions, large sample theory, statistical estimations & regression.
- f. Probability & random processes: (2019, 2020, 2021, 2022, 2023, 2024): Basic probabilistic modelling, probability distributions, large sample theory, Random processes.
- g. Linear algebra: (2017, 2018, 2020, 2022, 2023): system of linear equations & Gaussian elimination methods, central concepts of linear algebra, inner product & orthogonality, spectral theorem & matrix decompositions.
- h. Calculus: (2016, 2017, 2021): real number systems & calculus of one variable, Riemann integrations, calculus of several variables & local approximations, vector calculus & its applications.
- i. Differential equations (2017, 2018): 1<sup>st</sup> order ODEs & IVPs, 2<sup>nd</sup> order ODEs & BVPs, Series solutions & integral transforms, introduction to PDEs.

**TEACHING INTEREST WITH BRIEF SYLLABUS**

---

**Statistical learning:** statistical modelling & supervised learning framework, parameter estimations & numerical optimization, model selection & generalization, kernel methods & unsupervised learning.

**High dimensional probability & statistics:** Sub-gaussian & sub-exponential distributions, concentration inequalities & non-asymptotic bounds, random processes & chaining, HD linear models & parameter estimation.

**Dynamical systems & autonomous control:** Dynamical systems (DS) & its stability, statistical Parametric models bifurcation in DS & control, learning DS & control, autonomous control.

**Robotics & control:** feedback control, motion planning & trajectory prediction, state estimation localization and mapping, computer vision & learning.

**Data science:** descriptive statistics & data visualization, statistical estimation & goodness of fit, ML algorithms for regression & classifications, Python based programming.

**Markov chain & mixing times:** Introduction to Markov chain, Ergodicity & martingales, mixing times & coupling, learning dynamical systems & mixing time bounds.

**Statistical modelling:** Model structure & statistical models, statistical estimation & goodness of fit, linear models, generalized linear models.

**Time series analysis:** time series & stationary-non-stationary processes, auto-regressive & moving average models, spectral analysis & filtering, state-space models & parameter estimation.

**Empirical processes:** empirical processes & stochastic convergence, bootstrapping & delta function method, M-estimator & Z-estimator, semiparametric inference.

**Numerical linear algebra:** error, stability & conditioning in perturbation theory, direct methods for solving system of linear equations, iterative methods for solving linear systems, eigen-value problems & iterative methods for solving large linear systems.

**Randomized algorithms:** Discrete probability & conditioning, randomized & derandomization algorithm using conditional expectation, fundamental probabilistic inequalities, metric embedding & JL lemma, compress sensing & RIP, fundamental theorem of Markov chain & mixing times with coupling.

**Stochastic optimization:** introduction to stochastic optimization, gradient-based & gradient-free search techniques, Markov chain Monte Carlo techniques, dynamic programming & control.

**Deep-Gen-AI & dynamical models:** generative & dynamical models, Variational auto-encoder & GAN, Neural Des, Physics guided machine learning models.

**Non-linear algebra:** polynomials & varieties, solving & decomposing, mapping & projecting, linear spaces & Grassmannians, Nullstellensätze, tropical algebra & Toric varieties, tensors, representation & invariant theory, semidefinite programming.

**Computational control theory:** introduction to control & control algorithms, reinforcement learning & Markov decision process, qualitative & dynamical studies of dynamical systems, optimal control & learning dynamical systems.

**Computational differential geometry:** a local theory of curves & surfaces, hyperbolic geometry & calculus of variations, basic geometric algorithms, convex hull, simplicial complexes, Voronoi & arrangements, curve/surfaces reconstructions & mesh generations, topological data analysis.

**Differential equations & dynamical systems (DEDS):** Cauchy problem & its fundamental theorem, system of linear ODEs & matrix decompositions, non-linear DS & local theory, DS & global theory.

**Numerical analysis:** uncertainty & significance in measurement, Taylor's theorem & approximation, approximate solution & numerical methods, interpolation & numerical differentiation, numerical integration.

**Mathematical modelling:** First order models & nonlinear population models, inter & intra competitive models, epidemic & biological models, nonlinear dynamics & chaos.

**Partial differential equations:** 4 important linear PDEs (transport, Laplace, heat & wave eqns.), 1<sup>st</sup> order nonlinear PDEs, theory of linear PDEs, theory of nonlinear PDEs, calculus of variations.

**Functional analysis:** Normed linear spaces & metrics, fundamental theorem of normed linear space & its applications, inner product & Hilbert spaces with its applications, spectral theory of linear operators.

**Lagrangian & Hamiltonian dynamics:** review of Newtonian mechanics, Lagrangian mechanics & variational calculus, Hamiltonian mechanics & generalized co-ordinates.

**Smooth manifolds:** Point set & manifold topology, continuity, completeness & compactness, Hausdorff & countable space, locally Euclidean space & tangent-cotangent spaces, projective & smooth spaces.

#### ADMINISTRATIVE RESPONSIBILITIES

---

Member Secretary, Academic Regulation (Odd Semester, 2016), Member, Library Committee (5 Semesters 2016-Present)

Member, Academic Curriculum Committee (2 Semesters, 2018-2022), Faculty Coordinator (2nd Semester, Section-A, 2019) (1 Semester, 2019-present).

Member, Ph.D. Screening committee (December 2023 till date).

#### PUBLICATIONS

---

##### A. Conference proceedings:

1. L. Mahto, Learning algorithms for non-linear dynamical systems, control and autonomy, Conference on Applied AI and Scientific Machine Learning (CASML 2024), Indian Institute of Science, Bangalore, India, 2024.
2. Mahto, L., Computational and statistical complexities of learning algorithm for nonlinear dynamical systems, Indo-German conference on computational mathematics (IGCM-2023) held at Indian Institute of Science, Bangalore, India, 2023.
3. Chauhan, A., Jagadish, D.N. and Mahto, L., Multimodality Data Fusion for COVID-19 Diagnosis. In 2021 IEEE International Conference on Big Data (Big Data) (pp. 4659-4666), 15 Dec, 2021, doi:10.1109/BigData52589.2021.9671302, ISBN: 978-1-6654-3902-2.
4. Jagadish D.N., Chauhan A., Mahto L, Autonomous Vehicle Path Prediction Using Conditional Variational Autoencoder Networks. In: Karlapalem K. et al. (eds) Advances in Knowledge Discovery and Data Mining. PAKDD 2021. Lecture Notes in Computer Science, vol 12712, 129–139. Springer, Cham. [https://doi.org/10.1007/978-3-030-75762-5\\_11](https://doi.org/10.1007/978-3-030-75762-5_11), ISSN: 978-3-030-75762-5. (H-index: 182)

5. A. Chauhan, S. Kumar, L. Mahto and J. D. N, "Detection of Reckless Driving using Deep Learning," 2020 19th IEEE International Conference on Machine Learning and Applications (ICMLA), Miami, FL, USA, 2020, pp. 853-858, doi: 10.1109/ICMLA51294.2020.00139, ISSN: 978-1-7281-8470-8. (H-index: 18)
  6. J. D. N, L. Mahto and A. Chauhan, "Density Based Clustering Methods for Road Traffic Estimation," 2020 IEEE REGION 10 CONFERENCE (TENCON), Osaka, Japan, 2020, pp. 885-890, doi: 10.1109/TENCON50793.2020.9293790, ISSN: 978-1-7281-8455-5. (H-index: 38)
  7. Jagadish, D. N., Mahto, L., Chauhan A. (2021) Deep Learning and Density Based Clustering Methods for Road Traffic Prediction. In: Singh S.K., Roy P., Raman B., Nagabhushan P. (eds) Computer Vision and Image Processing. CVIP 2020. Communications in Computer and Information Science, vol 1378, 332–343, Springer, Singapore. [https://doi.org/10.1007/978-981-16-1103-2\\_29](https://doi.org/10.1007/978-981-16-1103-2_29), ISSN: 978-981-16-1103-2.
  8. Mahto, L., Abbas, S., Existence, and uniqueness of a solution of Caputo fractional differential equations, AIP Conf. Proc. 1479, 896-899 (2012). <https://doi.org/10.1063/1.4756286> , ISSN: 78-0-7354-1091-6. (H-index: 75)
  9. Abbas, S., Mahto, L., Existence of almost periodic solution of a model of phytoplankton allelopathy with delay, AIP Conf. Proc. 1479, 900-905 (2012). <https://doi.org/10.1063/1.4756287>, ISSN: 78-0-7354-1091-6. (H-index: 75)
- B. Workshop proceedings:
1. Mahto, L., Chauhan, A., An approximate gradient-based hyper-parameter optimization in a neural network architecture, NeurIPS 12th workshop on Optimization in Machine Learning (OPT2020), 2020. [https://opt-ml.org/papers/2020/paper\\_62.pdf](https://opt-ml.org/papers/2020/paper_62.pdf)
  2. D N., Jagadish, Chauhan, A., Mahto, L., Deep Learning Techniques for Autonomous Vehicle Path Prediction, AAAI workshop on the AI for Urban Mobility Workshop (AI4UM 2021). <https://aaai.org/Conferences/AAAI-21/ws21workshops/>
- C. Journal:
1. Jagadish, D.N., Chauhan, A. & Mahto, L. Conditional Variational Autoencoder Networks for Autonomous Vehicle Path Prediction. Neural Process Lett 54, 3965–3978 (2022). <https://doi.org/10.1007/s11063-022-10802-z> ISSN: 370-4621.
  2. Mahto, L.; Abbas, S., Hafayed, M., Srivastava, H.M., Approximate Controllability of Sub Diffusion Equation with Impulsive Condition. Mathematics, MDPI 2019, 7, 190. <https://doi.org/10.3390/math7020190>, ISSN: 2227-7390. (SCI indexed, IF=2.7, Q2)
  3. Abbas, S., Mahto, L., Favini, A., Hafayed, M., Dynamical analysis of a fractional model of phytoplankton allelopathy, Differential Equations and Dynamical Systems, Springer, 24 (3), pp 267–280, July 2016. <http://link.springer.com/article/10.1007/s12591014-0219-5>, ISSN: 971-3514. (Scopus indexed, Q3)

4. Mahto, L., Abbas, S., PC-almost automorphic solution of impulsive fractional functional differential equations, *Mediterranean Journal of Mathematics*, Springer, 12 (3), pp 771–790, July 2015. <http://link.springer.com/article/10.1007/s00009-014-0449-3>, ISSN: 1660-5446. (SCI indexed, IF=1.4, Q2)
  5. Abbas, S., Mahto, L., Hafayed, M., Alemi, F.M., Asymptotic almost automorphic solution of impulsive neural network with almost automorphic coefficients, *Neurocomputing*, Elsevier, 142 (22), October, 326-334, 2014). <https://doi.org/10.1016/j.neucom.2014.04.028>, ISSN: 0925-2312. (SCI indexed, IF=5.5, Q1)
  6. Mahto, L., Abbas, S., Approximate controllability and optimal control of impulsive fractional functional differential equations, *J. Abstr. Differ. Equ. Appl.*, 4 (2), 44–59, 2013. Doi: <http://mathres-pub.org/jadea/4/2/approximate-controllability-and-optimalcontrol-impulsive-fractionalfunctional>, ISSN: 2158-611X. (Mathscinet indexed, MCQ=0.3)
  7. Mahto, L., Abbas, S., Favini, A., Analysis of Caputo impulsive fractional-order differential equations with applications, *Int. J. Differ. Equ.*, 2013, Art. ID 704547, 11 pp, 2012. <http://dx.doi.org/10.1155/2013/704547> , ISSN: 1687-9643 (Scopus indexed, Q3)
- D. Book chapters:
1. Abbas S., Mahto L. (2019) Piecewise Continuous Stepanov-Like Almost Automorphic Functions with Applications to Impulsive Systems. In: Dutta H., Koćinac L., Srivastava H. (eds) *Current Trends in Mathematical Analysis and Its Interdisciplinary Applications*. Birkhäuser, Cham. [https://doi.org/10.1007/978-3-030-15242-0\\_4](https://doi.org/10.1007/978-3-030-15242-0_4). ISBN: 978-3-030-15241-3
- E. Books:
1. Mahto, Lakshman. "Introduction to probability and statistics: a computational framework of randomness." arXiv preprint arXiv:2401.08622 (2023).

#### FUNDED RESEARCH GRANTS

- 
1. Deep Learning Model for Autonomous Navigation on Indian Roads funded by SERB-DST under core research grants as a Co-PI, Status-Ongoing, Amount: 1761905

#### SELECTED TALKS

---

Invited talk on "Statistical learning algorithms of a nonlinear dynamical system and computation of its Lyapunov function" (30<sup>th</sup> May, 2023), Plaksha University, India.

Invited talk on "an optimization-based stability and learning of a dynamical system" (19<sup>th</sup> September 2022), Department of Industrial engineering and operation research, Indian Institute of Technology Bombay, India.

Invited talk on " Learning a dynamical system and its stability" (4<sup>th</sup> March 2022), School of AI (Mathematics), Indian Institute of Technology Delhi, India.

Invited talk on "an optimization-based stability and learning of a dynamical system" (10<sup>th</sup> November 2021), Department of Industrial engineering and operation research, Indian Institute of Technology Bombay, India.

Invited talk on " linear models with hands-on session on python" (22<sup>nd</sup> September 2021), in Five Days FDP on the Artificial Intelligence, organized by Department of Mathematics, Vinoba Bhave University Hazaribagh, India.

Invited talk on "an optimization-based stability and learning of a dynamical system" (28<sup>th</sup> April 2021), Department of Mathematics, Indian Institute of Science Education and Research Mohali, India.

Invited talk on "Principal Component Analysis" (25th July 2018), FDP on Machine Learning, Indian Institute of Information Technology Dharwad, India.

Invited talk on "Approximate controllability of sub-diffusion equations" (13th January 2017) at Department of Mathematics, Indian Institute of Science, Bangalore, India.

## LANGUAGES

---

**Hindi:** Native Language, **English:** Intermediate Listener, Novice Speaker, Advanced Reading, & Writing

## COMPUTER SKILLS

---

**Programming:** Python, R, MATLAB

## OTHER

---

Interests/Hobbies: Traveling, Gardening, Reading, Citizenship: Indian, ORCID: 0000-0003-4243-0706  
ResearcherID: C-7342-2013, Scopus Author ID: 55837107900

## REFERENCES:

---

Dr. Syed Abbas (Ph.D. supervisor), professor, SBS, Indian Institute of Technology Mandi, Phone: +91-88945-59352, Email: [abbas@iitmandi.ac.in](mailto:abbas@iitmandi.ac.in)

Dr. Jagadish D.N. (Research collaborator and colleague), assistant professor, ECE, Indian Institute of Information Technology Dharwad, Phone: +91-91138-39830, Email: [jagadishdn@iiitdwd.ac.in](mailto:jagadishdn@iiitdwd.ac.in)

Dr. Arun Chauhan (Research collaborator and former colleague), Associate Professor, CSE, Graphic Era University Dehradun, India, Phone: +91-80730-31596, Email: [aruntakhur@gmail.com](mailto:aruntakhur@gmail.com).

Dr. Vijay Bhaskar Semwal (Research collaborator and former colleague), Assistant Professor, CSE, MA National Institute of Technology Bhopal, India, Phone: +91-88741-42887, Email: [ysemwal@manit.ac.in](mailto:ysemwal@manit.ac.in)