

DR. ANUBHAB MAJUMDER

Research Associate II

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Research interests: *Design theory & methodology, conceptual design, applications of AI in design, LLMs and AI Agents, prompt engineering, multi-state mechanical devices, function modelling, design creativity, design-by-analogy, business model innovation, and robotics.*

CONTACT INFORMATION

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EDUCATION

Indian Institute of Science Bengaluru, Karnataka, India
Ph.D. (Engineering) in Product Design and Engineering August 2018 – July 2024
Dissertation: *Supporting Concept Representation, Synthesis, and Analysis of Multi-state Mechanical Devices*
(Dissertation submitted on 17 July 2024, Defended on 13 Nov 2024)
Supervisor: Prof. Amaresh Chakrabarti
GPA: 8.83/10

Indian Institute of Technology (ISM) Dhanbad Dhanbad, Jharkhand, India
M. Tech. in Mechanical Engineering (spl. Machine Design) August 2016 – May 2018
Thesis: *A Bio-inspired Climbing Robot: Dynamic Modelling and Prototype Development*
Supervisor: Prof. Sanjoy K. Ghoshal
GPA: 9.89/10 (Gold Medal)

Govt. College of Engineering and Textile Technology Berhampore, West Bengal, India
Affiliated to Maulana Abul Kalam Azad University of Technology (formerly West Bengal University of Technology), West Bengal, India
B. Tech. in Mechanical Engineering August 2012 – May 2016
GPA: 9/10

WORK EXPERIENCE

Indian Institute of Science

Bengaluru, Karnataka, India

Research Associate II, Department of Design and Manufacturing

February 2024 – Present

Mentors: Prof. Amaresh Chakrabarti, Prof. Vishal Singh

- Working as a part of Work Package 6 in the PISCES project
- Responsible for the design and development of the PISCES Living Lab, integrating engineering design and business model innovation to address plastic pollution in Indonesia.
- Coordinated three workshops in Banyuwangi, Indonesia, engaging stakeholders from the project to develop and refine the business model for the PISCES Living Lab.
- Collaborated with senior faculties and researchers from Brunel University of London (UK), ITS (Surabaya, Indonesia), ITB (Bandung, Indonesia), and Udayana University (Bali, Indonesia).

HONORS, AWARDS & SCHOLARSHIPS

Academic Honors

A1. **Gold Medal**, IIT (ISM) Dhanbad (2018)

Awarded the institute gold medal for achieving the highest academic standing in the graduating batch, with a CGPA of 9.89/10, at the Indian Institute of Technology (ISM) Dhanbad.

Research Awards

A2. **Distinguished Paper Award**, ICoRD'25, IIT Hyderabad, India (2025)

Awarded for the Paper titled "A Study on Effect of Reference Knowledge Choice in Generating Technical Content Relevant to SAPPhIRE Model Using Large Language Model."

A3. **Reviewers' Favourite Award**, ICED'23, Bordeaux, France (2023)

Awarded for the Paper titled "Development of a design support tool for synthesising multi-state mechanical device concepts."

A4. **Distinguished Paper Award**, ICoRD'23, IISc, India (2023)

Awarded for the Paper titled "Using SAPPhIRE for Functional Modelling of Multi-state Systems."

A5. **Best Paper Award**, ICMMRE'17, SMIT, Sikkim, India (2017)

Awarded for the Paper titled "A bio-inspired climbing robot: design, simulation, and experiments."

Fellowships & Scholarships

A6. **PhD Fellowship**, Ministry of Education, Govt. of India (2018 – 2023)

Awarded the Junior Research Fellowship (JRF) and Senior Research Fellowship (SRF) for pursuing PhD at the Indian Institute of Science (IISc).

A7. **GATE Scholarship**, Ministry of Education, Govt. of India (2016 – 2018)

Awarded for securing a 98.3 percentile in the GATE exam to pursue an M.Tech. at IIT (ISM) Dhanbad.

- A8. **National Scholarship**, Ministry of Education, Govt. of India (2012 – 2016)
Awarded under the "Central Sector Scheme of Scholarship for College and University Students" for scoring above the 80th percentile in the Class XII state board examination to support undergraduate studies.

PROFESSIONAL SERVICES

- P1. *Social Media Editor*, AI EDAM Journal, Cambridge University Press, February 2025 – Present.
- P2. *Organizing committee member*, 4th International Conference on Industry 4.0 and Advanced Manufacturing (I-4AM'26), IISc, India, 2026.
- P3. *Organizing committee member*, 3rd International Conference on Industry 4.0 and Advanced Manufacturing (I-4AM'24), IISc, India, 2024.
- P4. *Lead volunteer*, I-4AM'24 Robotics Challenge, IISc, India, 2024.
- P5. *Organizing committee member*, 9th International Conference on Research into Design (ICoRD'23), IISc, India, 2023.
- P6. *Volunteer*, International Symposium on Future of Design Education (InFuSED'23), IISc, India, 2023.
- P7. *Organizing committee member*, 2nd International Conference on Industry 4.0 and Advanced Manufacturing (I-4AM'22), IISc, India, 2022.
- P8. *Organizing committee member*, 8th International Conference on Research into Design (ICoRD'21), IIT Bombay, India, 2021.
- P9. *Volunteer/ Host*, Pre-Conference Workshop of 7th International Conference on Product Life Cycle Modelling, Simulation and Synthesis (PLMSS'19), Bengaluru, India, 2019.
- P10. *Volunteer/ Host for Parallel Sessions*, 1st International Conference on Industry 4.0 and Advanced Manufacturing (I-4AM'19), IISc, India, 2019.
- P11. *Organizing committee member*, 7th International Conference on Research into Design (ICoRD'19), IISc, India, 2019.
- P12. *Mentor*, IISC DBox – Design Thinking workshops for undergraduate and school students organized by the Department of Design and Manufacturing, IISc, India, 2019 – 2023.

TEACHING EXPERIENCE

- T1. *Co-instructor*, Centre of Excellence in Design (D-CoE), IISc, India, 2025
Module: Design Thinking and Methodology
Instructor: Prof. Amaresh Chakrabarti
My contributions:
- Prepared part of the course materials focusing on applications of Generative AI (GenAI) in design thinking (DT) process.
 - Delivered lectures to the in-house trainers of the D-CoE on the following topics:
Introduction to Gen-AI, Prompt Engineering essentials for designers, and Cutting-edge GenAI tools to support DT process.

T2. *Plant Simulation Instructor*, Indian Institute of Science (IISc), India, 2022

Module: Digital Manufacturing

Program: PG Level Advanced Certification Programme in Digital Manufacturing and Smart Factories

My contributions:

- Prepared lecture materials and delivered lectures on Discrete-Event Simulation (DES).
- Introduced industry professionals to Tecnomatix Plant Simulation software.

T3. *Teaching Assistant*, Department of Mechanical Engineering, IIT(ISM) Dhanbad, India, 2017 – 2018.

Instructor: Prof. Sanjoy K. Ghoshal

Responsibilities: checking assignments, holding office hours, and other admin work.

WORKSHOPS DELIVERED & ATTENDED

W1. *Co-chair*, “Practicing Causal Reasoning in Product Design using the SAPPhIRE Model and GenAI” at the 10th International Conference on Research into Design (ICoRD’25, Day-1, Parallel Workshop WS-110), 8 January 2025.

W2. *Coordinator*, “3rd PISCES entrepreneurship workshop,” Banyuwangi, Indonesia, 2 – 6 December 2024.

W3. *Coordinator*, “2nd PISCES entrepreneurship workshop,” Banyuwangi, Indonesia, 19 – 23 August 2024.

W4. *Coordinator*, “1st PISCES entrepreneurship workshop,” Banyuwangi, Indonesia, 22 – 26 April 2024.

W5. *Attendee*, “DRM Gurukool 2023: The First Indian Summer School on Design Research,” Indian Institute of Science, Bengaluru, India, 2 – 7 July 2023.

W6. *Co-chair*, “How to build the SAPPhIRE model of causality representing the working of engineering systems” at the 9th International Conference on Research into Design (ICoRD’23, Day-3, Parallel Session 4), 11 January 2023.

W7. *Attendee*, “PBL South Asia Training Workshop for Faculty and Advanced Students,” Indian Institute of Technology Bombay, Mumbai, India, 19 – 30 August 2019.
Project title: Livability in Slums; Collaborated with faculties and researchers from Bhutan, Nepal, Lithuania, and the Netherlands.

INVITED TALKS

IT1. *Speaker*, “Supporting Concept Representation, Synthesis, and Analysis of Multi-state Mechanical Devices,” Sharing to gain webinar series, Systems Realization Laboratory, The University of Oklahoma, United States, 7 February 2025.

IT2. *Co-presenter*, “PISCES Relay: The Living Lab Enterprise,” 3rd Annual Meeting of the Plastics in Indonesian Societies (PISCES) Partnership and Program – A Systems Approach to Tackling Plastic Pollution in Indonesia, Banyuwangi, Indonesia, 4 December 2024.

SEMINARS ATTENDED

- S1. *Attendee*, “Seminar on Ergonomics,” organized by Department of Mechanical Engineering, Government College of Engineering & Textile Technology Berhampore, West Bengal, India, 17 February 2014.
- S2. *Attendee*, “The National Seminar on Recent Advances in Mechanical Engineering,” organized by Department of Mechanical Engineering, Government College of Engineering & Textile Technology Berhampore, West Bengal, India, 28 – 29 October 2013.

PUBLICATIONS

Ph. D. Dissertation

Majumder, A. (2024). “Supporting Concept Representation, Synthesis, and Analysis of Multi-state Mechanical Devices,” Indian Institute of Science, Bengaluru, India. Electronic copy available at: <https://etd.iisc.ac.in/handle/2005/6694>

M. Tech. Thesis

Majumder, A. (2018). “A Bio-inspired Climbing Robot: Dynamic Modelling and Prototype Development,” Department of Mechanical Engineering, Indian Institute of Technology (ISM) Dhanbad, India.

Peer-reviewed Journal Articles

- J1. **Majumder, A.**, Pal, U., & Chakrabarti, A. “Assessing Variety of a Concept Space using SAPPhIRE Model of Causality,” *Artificial Intelligence for Engineering Design, Analysis and Manufacturing* (In review) [arXiv preprint arXiv:2408.00684]
- J2. **Majumder, A.**, & Chakrabarti, A. “Development and Evaluation of CoDe SyMM-a Tool to Facilitate Conceptual Design Synthesis of Multi-State Mechanical Devices,” *ASME Journal of Mechanical Design*. DOI: 10.1115/1.4066442
- J3. Bhattacharya, K., **Majumder, A.**, Bhatt, A., Keshwani, S., Ranjan, BSC., Venkataraman, S., & Chakrabarti, A. (2024). “Developing a Method for Creating a Structured Representation of Working of Systems from Natural Language Description using SAPPhIRE Model of Causality,” *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*. 38, e24. DOI: 10.1017/S0890060424000118
- J4. **Majumder, A.**, Todeti, S. R., & Chakrabarti, A. (2023). “Empirical studies on conceptual design synthesis of multiple-state mechanical devices.” *Research in Engineering Design*, 34(4), 477-495. DOI: 10.1007/s00163-023-00420-8
- J5. **Majumder, A.**, & Chakrabarti, A. (2022). “A Tool for Supporting Conceptual Design of Multiple State Mechanical Devices,” *Defence Science Journal*, 72(2), 217-226. DOI: 10.14429/dsj.72.17240
- J6. Bhatt, A. N., **Majumder, A.**, & Chakrabarti, A. (2021). “Analyzing the modes of reasoning in design using the SAPPhIRE model of causality and the Extended Integrated

- Model of Designing,” *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, 35, 384–403. DOI: 10.1017/S0890060421000214
- J7. Chattopadhyay, P., Ghoshal, S. K., **Majumder, A.** (2020). “Implementation of piecewise sine functions on limbless robot locomotion,” *International Journal of Robotics and Automation*, 35(4). DOI: 10.2316/J.2020.206-0159
- J8. Chattopadhyay, P., Ghoshal, S., **Majumder, A.**, Dikshit, H. (2018). “Locomotion Methods of Pipe Climbing Robots: A Review,” *Journal of Engineering Science and Technology Review*, 11(4). DOI: 10.25103/jestr.114.20

Peer-reviewed Conference Papers

- C1. **Majumder, A.**, Fahrisa, Titing Reza., Gerassimidou, S., Yudoko, G., Jobling, S., Iacovidou, E., Singh, V., & Chakrabarti, A. “Adapting the Engineering Design Process to Develop a Business Model for Service-Oriented Living Labs: A Case Study of PISCES,” *25th International Conference on Engineering Design (ICED’25)* (Accepted)
- C2. **Majumder, A.**, Bhattacharya, K., & Chakrabarti, A. “Development and Evaluation of a Retrieval-Augmented Generation Tool for Creating SAPPhIRE Models of Artificial Systems,” *10th International Conference on Research into Design (ICoRD’25)*, Indian Institute of Technology (IIT), Hyderabad, India, 2025. (Accepted) [arXiv preprint arXiv:2406.19493]
- C3. Bhattacharya, K., **Majumder, A.**, & Chakrabarti, A. “A Study on Effect of Reference Knowledge Choice in Generating Technical Content Relevant to SAPPhIRE Model Using Large Language Model,” *10th International Conference on Research into Design (ICoRD’25)*, Indian Institute of Technology (IIT), Hyderabad, India, 2025. (Accepted) [arXiv preprint arXiv:2407.00396]
- C4. **Majumder, A.**, Bhatt, A. N., & Chakrabarti, A. “Using SAPPhIRE for Functional Modelling of Multi-state Systems,” *9th International Conference on Research into Design (ICoRD’23)*, Indian Institute of Science, Bangalore, India, 2023. DOI: 10.1007/978-981-99-0428-0_62
- C5. **Majumder, A.**, & Chakrabarti, A. “Development of a design support tool for synthesising multi-state mechanical device concepts,” *24th International Conference on Engineering Design (ICED’23)*, University of Bordeaux, France, 2023. DOI: 10.1017/pds.2023.146
- C6. **Majumder, A.**, & Chakrabarti, A. “A Causal Representation Scheme for Capturing Topological Changes in Multi-state Mechanical Devices,” *2nd International and 14th National Conference on Industrial Problems on Machines & Mechanisms (IProMM’22)*, Indian Institute of Technology (ISM) Dhanbad, India, 2022. DOI: 10.1007/978-981-99-4270-1_1
- C7. **Majumder, A.**, Patra, A., Patel, M., Chattopadhyay, P., & Ghoshal, S. K. “Locomotion Study of a Hyper-redundant Modular Robot Using Artificial Neural Networks,” *4th*

- International Conference on Advances in Robotics (AIR'19)*, Indian Institute of Technology (IIT) Madras, Chennai, India, 2019. DOI: 10.1145/3352593.3352619
- C8. Chattopadhyay, P., **Majumder, A.**, Dikshit, H., Ghoshal, S. K., & Maity, A. “A bio-inspired climbing robot: design, simulation, and experiments,” *International Conference on Mechanical, Materials and Renewable Energy (ICMMRE'17)*, Sikkim Manipal Institute of Technology, Sikkim, India, 2017. DOI: 10.1088/1757-899X/377/1/012105
- C9. Chattopadhyay, P., Dikshit, H., **Majumder, A.**, Ghoshal, S., & Maity, A. “Dynamic analysis of a bio-inspired climbing robot using ADAMS-Simulink co-simulation,” *International Conference on Electrical, Electronics, Materials and Applied Science (ICEEMAS'17)*, Swami Vivekananda Institute of Technology (SVIT), Secunderabad, India, 2017. DOI: 10.1063/1.5031977
- C10. Patra, A., Patel, M., Chattopadhyay, P., **Majumder, A.**, & Ghoshal, S.K. “A Bio-inspired Climbing Robot: Dynamic Modelling and Prototype Development,” *National Conference on Advances in Mechanical Engineering (NCAME'19)*, National Institute of Technology (NIT) Delhi, New Delhi, 2019. DOI: 10.1007/978-981-15-1071-7 17
- C11. Patel, M., Patra, A., Chattopadhyay, P., **Majumder, A.**, & Ghoshal, S. K. “Evolution of a Modular Limbless Crawling and Climbing Robot,” *National Conference on Advances in Mechanical Engineering (NCAME'19)*, National Institute of Technology (NIT) Delhi, New Delhi, 2019. DOI: 10.1166/ase.2020.2590

DESIGN SUPPORT TOOLS DEVELOPED

- D1. **CoDeSyMM** – A web-based tool for supporting the synthesis of Multi-State Mechanical Devices (MSMD) – Given a set of behavioural specifications, the tool helps designers identify a set of partial solutions and guides them to synthesize a wider range of design concepts by providing relevant modification rules and examples, supplemented with interactive 3D animations. ([more details](#))
- D2. **VariAnT** – a Python-based tool for evaluating the variety/diversity within a design concept space. Employing state-of-the-art NLP techniques, the tool analyses a concept space represented using the SAPPhIRE ontology. It provides variety scores for individual concepts, the overall concept space, and at various levels of abstraction. Additionally, VariAnT aids in clustering concepts to visualize groups of similar concepts. ([more details](#))
- D3. **IDEA-INSPIRE (Web Version)** – A web-based tool for supporting design-by-analogy. The tool uses a RAG framework and leverages Large Language Models to help transform unstructured content (e.g., PDF of a Wikipedia article) into structured system descriptions (analogues) based on the SAPPhIRE ontology. ([more details](#))

MENTORING

- M1. **Sahana Parasuram** (Undergraduate Intern at DM, IISc, Summer 2024): Co-mentored a project on developing a RAG pipeline for extracting text data from unstructured documents and generating a Design Structure Matrix (DSM). Guided an empirical study evaluating Large Language Models for Automated DSM extraction from patent documents.

M2. **Asesh Patra & Meet Patel** (M.Tech. Students at Dept. of ME, IIT Dhanbad, 2018-2019): Co-mentored their final year M.Tech. projects, which extended my own M.Tech. thesis work. Guided the development of a hyper-redundant modular robot capable of mimicking caterpillar and inchworm locomotion. The project resulted in three conference papers (C7, C10, C11).

SKILLS

- **Software packages:** OPCAT, MSC ADAMS, AUTOCAD, MAPLE, MATLAB, Tecnomatix Plant Simulation
- **Web/App Development:** HTML, PHP, JavaScript, Python, VPython, PySimpleGUI, LLMs, Langchain, TruLens.
- **Development Boards:** Arduino, Raspberry Pi
- **Languages:** Bengali, English, Hindi

INDUSTRIAL TRAINING

- *Trainee*, Damodar Valley Corporation, Mejia Thermal Power Station, West Bengal, India, 13 – 31 July 2015.

REFERENCES

Prof. Amaresh Chakrabarti

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Indian Institute of Science, Bengaluru–560012, Karnataka, India

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Prof. Sanjoy K. Ghosal

Professor at the Department of Mechanical Engineering,
Indian Institute of Technology (ISM) Dhanbad, Dhanbad–826004, Jharkhand, India

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