Dr. Anubhab Majumder

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Research interests

Design theory & methodology, conceptual design, applications of AI in design, multi-state mechanical devices, function modelling, design creativity, design-by-analogy, and robotics.

Work Experience

Research Associate II February 2024 – Present
Department of Design and Manufacturing, Indian Institute of Science, Bengaluru, India
Working as a part of Work Package 6 in the PISCES project [www.piscespartnership.org]

Education

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

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

B. Tech. in Mechanical Engineering August 2012 – May 2016
Government College of Engineering and Textile Technology Berhampore, West Bengal, India
GPA: 9.00/10

Higher Secondary Examination Year of Passing: 2012
Board: West Bengal Council of Higher Secondary Education
Score: 87.4%

Secondary Examination Year of Passing: 2010
Board: West Bengal Board of Secondary Education
Score: 82.9%

Honors and scholarships

Distinguished Paper Award (ICoRD 2025, India)	2025
Reviewers' Favourite Award (ICED 2023, France)	2023
Distinguished Paper Award (ICoRD 2023, India)	2023
IIT(ISM) Gold Medal (Indian Institute of Technology (ISM), Dhanbad)	2018
Best Paper Award (ICMMRE 2017, India)	2017
GATE Scholarship (Ministry of Education, Govt. of India)	2016 – 2018
National Scholarship (Department of Higher Education, Ministry of Education, Govt. of India)	2012 – 2016

Professional Activities

Member of the Organising Committee
–International Conference on Industry 4.0 and Advanced Manufacturing: I-4AM'19, I-4AM'22, & I-4AM'24*
–International Conference on Research Into Design: ICoRD'19, ICoRD'21, & ICoRD'23
*Led the volunteer team for the I-4AM'24 Robotics Challenge.

Volunteer/ Host 16 – 17 December 2019
Pre-Conference Workshop of 7th International Conference on Product Life Cycle Modelling, Simulation and Synthesis (PLMSS) - 2019, Bengaluru.

Mentor May 2019 – February 2023
IISC DBox – Design Thinking workshops for undergraduate and school students organized by the Department of Design and Manufacturing, IISc, Bengaluru.

Workshop Co-chair 11 January 2023
Title: *How to build the SAPPhIRE model of causality representing the working of engineering systems*
9th International Conference on Research Into Design (ICoRD'23, Day-3, Parallel Session 4)

Workshop Co-chair 8 January 2025
Title: *Practicing Causal Reasoning in Product Design using the SAPPhIRE Model and GenAI*
10th International Conference on Research Into Design (ICoRD'25, Day-1, Parallel Workshop WS-110)

Tools Developed

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 synthesise a wider range of design concepts by providing relevant modification rules and examples, supplemented with interactive 3D animations. (more details)

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 visualise groups of similar concepts. (more details)

IDEA-INSPIRE (Web Version) — A web-based tool for supporting design-by-analogy – helps transform unstructured content (e.g., PDF of a Wikipedia article) into structured system descriptions (analogues) based on the SAPPhIRE ontology. (more details)

Workshops Attended

DRM GURUKOOLL 2023: The First Indian Summer School on Design Research 02 – 07 July 2023
Indian Institute of Science, Bengaluru, India.

PBL South Asia Training Workshop for Faculty and Advanced Students 19 – 30 August 2019
Indian Institute of Technology Bombay, Mumbai, India.

Skills

Software packages: OPCAT, MSC ADAMS, AUTOCAD, MAPLE, MATLAB, Tecnomatix Plant Simulation
Web/App Development: HTML, PHP, JavaScript, Python, VPython, PySimpleGUI, LLMs
Languages: Bengali, English, Hindi

Industrial Training

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

Peer-reviewed Journal Articles

1. **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]

2. **Majumder, A.**, & Chakrabarti, A. Development and Evaluation of CoDe SyMM-a Tool to Facilitate Conceptual Design Synthesis of Multi-State Mechanical Devices. *Journal of Mechanical Design.* DOI: 10.1115/1.4066442

3. 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

4. **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

5. **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

6. 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

7. 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

8. 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

International Conferences

1. **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) (In review)

2. **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]

3. 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]

4. **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

5. **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

6. **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

7. **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

8. 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

9. 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

National Conferences

1. 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

2. 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/asem.2020.2590