Purnendu

Postdoctoral Researcher

Institute of Electrical and Micro Engineering, EPFL Switzerland

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Research Interests

Wearable Technologies. Actuators and Sensors. Haptics. Human-machine Interaction. Augmented and Virtual Reality. Computational Fabrication. Additive Manufacturing. Nanomaterials. Graphene. My research envisions creating interactive machines rooted in material science.

Education

University of Colorado Boulder — *Boulder, Colorado, USA*

Ph.D. (Interdisciplinary Engineering/ Creative Technologies and Design) — *2018-2023*

- Cross-disciplinary research spanning Mechanical Engineering, Design, Electrical and Computer Engineering.
- Dissertation: Dadhichi- Electrostatic Manipulation of Soft Matter for Rendering Reality

Indian Institute of Technology, Roorkee (IIT Roorkee) — *Roorkee, India*

Integrated M.Sc. (Physics) — *2013 - 2018*

Experience

Swiss Federal Institute of Technology, Lausanne (EPFL) — *Neuchâtel, Switzerland*

Postdoctoral Researcher — *Feb 2024 - Present*

- Creating next generation of wearable/implantable devices integrating soft actuators and neural interfaces.

Meta Inc. (Reality Labs Research) — *Redmond, Washington, USA*

Research Intern / Contract Researcher — *Jan 2022 - Dec 2022*

- Designed and built a soft wearable haptic device for the fingertip for Mixed Reality environments.

Max Planck Insitute for Informatics — *Saarbrücken, Germany*

Visiting Researcher — *Dec. 2017 - April 2018*

- Designed and Constructed Acoustic Metamaterials for Ultrasonic sensing.

Log 9 Materials — *Roorkee, India*

Co-founder and CTO — *Sept. 2015 - Oct. 2016*

- Developed graphene-nanotechnology based commercial applications on a wide variety of projects.

Bauhaus University — *Weimar, Germany*

Research Intern — *May 2017-Jul. 2017*

- Built soft robotic TUI (Tangible User Interfaces) exploring ultrasonic sensing

Design Studio, IIT Roorkee — *Roorkee, India*

Co-founder and President — *July 2016 - May 2017*

- Design Studio, is the design club at IIT Roorkee. I co-founded the group and lead it from its inception as the founding President.

UI/UX Designer — *India*

Freelance — *Dec. 2013 - May 2015*

- Managed a wide variety of cross-media projects involving branding, illustrations, animations, products, UI-UX design, and development for startups (Inst-E-Shop, AAYUU.com, to name a few) as well as industry leaders.

Publications

[6] Electrostatic Manipulation of viscous threads: Towards 3D Printing. Purnendu, Madhur Atreya, Teis Hart, Gregory Whiting, Carson Bruns. *[Under submission to Advanced Functional Materials (Wiley), 2024.]*

[5] Fingertip Wearable High-resolution Electrohydraulic Interface for Multimodal Haptics. Purnendu, Jess Hartcher-O'Brien, Vatsal Mehta, Nicholas Colonnese, Aakar Gupta, Carson Bruns, and Priyanshu Agarwal. *In Proc. of IEEE World Haptics Conference (WHC), 2023, pp. 299–305.* https://doi.org/10.1109/WHC56415.2023.10224383

[4] Electriflow: Augmenting Books With Tangible Animation Using Soft Electrohydraulic Actuators. Purnendu, Sasha Novack, Eric Acome, Mirela Alistar, Christoph Keplinger, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In Special Interest Group on Computer Graphics and Interactive Techniques Conference Labs (SIGGRAPH '21 Labs), August 09-13, 2021. ACM, New York, NY, USA, 5 pages.* https://doi.org/10.1145/3450616.3464523

[3] Electriflow: Soft Electrohydraulic Building Blocks for Prototyping Shape-changing Interfaces. Purnendu, Sasha Novack, Eric Acome, Christoph Keplinger, Mirela Alistar, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In Designing Interactive Systems Conference 2021 (DIS '21), June 28-July 2, 2021, Virtual Event, USA. ACM, New York, NY, USA, 10 pages.* https://doi.org/10.1145/3461778.3462093

[2] Soft Electrohydraulic Actuators for Origami Inspired Shape-Changing Interfaces. Purnendu, Eric Acome, Christoph Keplinger, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '21 Extended Abstracts), May 8–13, 2021, Yokohama, Japan. ACM, New York, NY, USA.* https://doi.org/10.1145/3411763.3451590

[1] Graphene-Based 3D Xerogel as Adsorbent for Removal of Heavy Metal Ions from Industrial Wastewater. Purnendu, Soumitra Satapathi, 5, 2, 96-102,2017, Journal of Renewable Materials. https://doi.org/10.7569/JRM.2016.634134

Patents

[4] Systems and Methods of Generating High-density Multimodal Haptic Responses Using an Array of Electrohydraulic-controlled Haptic Tactors, and Methods of Manufacturing Electrohydraulic-controlled Haptic Tactors for Use Therewith. Priyanshu Agarwal, Purnendu, [United States Provisional Patent, App No. 63/404,164, Filed: September 6, 2022 (pending)]

[3] Method and apparatus for multi-material, battery-powered, Palmtop 3D-Printing. Purnendu, Carson Bruns, Mark D Gross [Provisional Patent Application No 63/283,873, Filed: 2021 (pending)]

[2] A graphene based tobacco smoke filter and a method for synthesizing graphene composition. Akshay V. Singhal, Purnendu [WO 2017187453 A1]

[1] Device and method for real-time thickness controlled spin-coating. Nipun Sawhney, Purnendu, Soumitra Satapathi [E-106/43/2016/DEL/201611039173 - (pending)].

Posters

[1] Graphene-Chitosan Xerogel for Heavy Metal Ion Removal. Purnendu, Soumitra Satapathi, International Conference On Nanoscience and Technology (ICONSAT), 2016, IISER PUNE]

Selected Press

2021 **TechExplore ,** Origami comes to life with new shape-changing materials

2021 **Hackster.io ,** New Shape-Changing Materials Come to Life Using Artificial Muscles

2021 **Science Daily ,** Origami comes to life with new shape-changing materials

2021 **Electronics Weekly ,** Electro-hydraulic actuator animates soft mini-robots

2021 **The Institution of Engineering and Technology ,** Paper-thin origami-like artworks wriggle, flutter and bend

2021 **Archinect ,** Electriflow taps advancements in soft robotics to create mechanisms that operate without traditional machine parts

2016 **The Times of India ,** IIT-R researcher develops cigarette filter that eliminates most chemicals from smoke

Invitations and Talks

University of Wisconsin Madison: Hosted by James Pikul, Sept. 2023;
Title: Electrohydraulic Machines for Soft-matter Manipulation

University of California Los Angeles: Hosted by Qibing Pei, May 2023;
Title: Inventing Soft Things to Solve Hard Problems

John Hopkins University: Hosted by David Gracias, May 2023;
Title: Electrohydraulic Machines for Soft-matter Manipulation

Boston University: Hosted by Keith Brown, March 2023 ;
Title: Soft Electrohydraulic Machines for Material Manipulation

Indian Institute of Science: Hosted by Amaresh Chakrabarti, June 2023;
Title: Towards Mobile 3D-Printing: Reimagining Personal Fabrication

Indian Institute of Technology, Gandhinagar: Hosted by Vineet Vashista, June 2023;
Title: Inventing Soft Things to Solve Hard Problems

Indian Institute of Technology, Patna: Hosted by Karali Patra, June 2023;
Title: Inventing Soft Things to Solve Hard Problems

University of Colorado, Boulder: ATLAS Seminar, hosted by Ellen Yi-Luen Do, November 2021;
Title: Mobile 3D-Printing: Reimagining Personal Fabrication

University of Colorado, Boulder: ATLAS Seminar, hosted by Ellen Yi-Luen Do, April 2020;
Title: Manipulating Shape of Things to come: Folding and Self Assembly

University of Colorado, Boulder: Statistics, Optimization and Machine Learning Seminar, hosted by Stephen Becker, Oct. 2019, Title: The mathematical secrets of Computational Origami.

NITTTR Chandigarh (India), Short-term program on Make-In-India-Issues and Challenges, Nov. 2017; Future of Graphene in manufacturing.

Make-In-India Week, Mumbai (India), Feb. 2016; Special Invitee.

Reviewer

Journals: Advanced Functional Materials, Advanced Science, Small Methods, Advanced Materials Technologies, Advanced Healthcare Materials, Macromolecular Rapid Communications, Nano Select, Chemistry Select, Chemistry Open

Conferences: ACM CHI 2024, 2021, 2020, 2019 ; ACM TEI 2024; ACM DIS 2021.

Awards and Honors

2023 **Graduate School international Travel Grant ,** University of Colorado Boulder
2023 **ATLAS Travel Grant ,** University of Colorado Boulder
2023 **Special Recognition for Outstanding Reviews ,** ACM Conference on Human Factors in Computing, 2024
2022 **Beverly Sears Graduate Student Grant ,** University of Colorado Boulder
2021 **Special Recognition for Outstanding Reviews ,** ACM Conference on Designing Interactive Systems, 2021
2018 **Dean's Scholarship ,** University of Colorado Boulder
2013-18 **Inspire Scholarship for Higher Education (SHE) ,** Ministry of Education, Govt. of India

Mentoring

Teis Hart: Undergraduate student in Mechanical Engineering, University of Colorado Boulder; Project: Designing a miniature 3D Printer

Aniket Agarwal: Master's Student in Creative Technology and Design, University of Colorado Boulder

Marian Baldonado: Master's student in Creative Technology and Design, University of Colorado Boulder

Cassidy Jensen: Undergraduate student in Creative Technology and Design, University of Colorado Boulder; Project: Acoustic Metamaterials

Vishal Shenoy: Master's student in Mechanical Engineering, University of Colorado Boulder

Ankit Kumar: Undergraduate student in Physics, IIT Roorkee

Teaching Experience

Computational Fabrication (Graduate: CSCI 7000/ATLS 5519) *Boulder, CO, USA*

Teaching Assistant *Fall 2023*

- This course teaches techniques, representations, and workflows for computational fabrication i.e blending computer programming with Digital fabrication machines like 3D printers and laser-cutters. Students use techniques to design and build functional, creative objects leveraging existing computer-aided design (CAD) tools, programming languages and digital fabrication machinery.

FORM (Undergraduate: ATLS 3100) *Boulder, CO, USA*

Teaching Assistant *Spring 2021*

- The course teaches the fundamentals of 3D modeling, 3D animation (using Rhinoceros 3D and Grasshopper) and 3D printing / rapid prototyping from a conceptual and sculptural perspective.

Graduate Coursework

Computer Science: Design and Ananlysis of Algorithms, Natural Language Processing, Applied Machine Learning, Theory of Computation, Bio-inspired Multi-Agent Systems, Quantum Information and Computing [all at CU Boulder]

Design: Haptic Interfaces, Metamaterial Design Principles [all at CU Boulder]

Mathematics: Partial Differential Equations [at CU Boulder]

Physics: Quantum Information and Computing, Advanced Condensed Matter Physics, Physics of Nanosystems, Physics and Technology of Thin Films, Advanced Characterization Techniques, Molecular Spectroscopy and Lasers [at IIT Roorkee]

Skills

ADVANCE SKILLS in actuator design and development: Peizoelectric, Electromagnetic and Electrostatic Actuators design and development. Fabrication techniques including Soft Lithography, Elastomer Fabrication and Various methods of thermosetting plastics.

ADVANCE SKILLS in high-voltage electronics: The design and creation of high-voltage (1kV-10 kV) power electronics and circuits. Extensive experience with DC-DC converters, switching mode power supplies and optical switches.

ADVANCE SKILLS in electronic hardware design and assembly: Digital and analog circuit design, signal processing, microprocessors, fast-prototyping as well as machine building.

ADVANCE SKILLS in Nano-material fabrication and experimentation: Including microfluidic control and study, soft-lithography, photolithography, thin film deposition, nanofabrication, chemical fabrication, wet-lab techniques, different types of spectroscopy (Fluorescence, UV-Visible, FTIR), X-Ray Diffraction, Atomic Force Microscopy and Electron Microscopy (SEM, TEM, STM) and instrumentation.

ADVANCE SKILLS in macro-scale instrumentation, prototyping, and digital fabrication: 3D printing, cutting, molding, casting; instrumentation of most digital machines to handle plastic/composite/metal/wood.

ADVANCE SKILLS in Design thinking, Design software in both 2D and 3D: (Adobe Creative Suite, Autodesk Softwares, Rhino with Grasshopper, Cinema-4D, Blender).

MEDIUM SKILLS in software development and scientific computing: Graphics, Animation, and Machine Learning in Python, MATLAB, Javascript, FORTRAN.

MEDIUM SKILLS in sensor design and development: Fabrication for a variety of sensors (capacitive, resistive, magnetic, acoustic) as well as their control electronics and interaction design leveraging them.

MEDIUM SKILLS in solid mechanics and finite element analysis: Digital and analog circuit design, signal processing, microprocessors, fast-prototyping as well as machine building.

Fluent in spoken and written English, Hindi, and Maithili (mother tongue). Vocational proficiency in Bengali and Sanskrit.

References

Available upon request