Purnendu

Curriculum Vitae (updated: May 9, 2023)

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Research Interests

Soft Robotics. Additive Manufacturing. Computational Fabrication. Haptics. Nanomaterials. Graphene. My research envisions creating interactive machines rooted in material science.

Education

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

PH.D. (ATLAS INSTITUTE/ CREATIVE TECHNOLOGIES AND DESIGN) — *Aug. 2018 - Aug. 2023 (expected)*

- Dissertation: Electrohydraulic Machines for Soft-matter Manipulation

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

INTEGRATED M.SC. (PHYSICS) — *Jul. 2013 - Jun. 2018*

Experience

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

RESEARCH INTERN / CONTRACT RESEARCHER — *Jan 2022 - Dec 2022*

- Design and built on soft wearable haptic device for the fingertip. Work resulted in a patent and publication.

Max Planck Insitute for Informatics — *Saarbrücken, Germany*

VISITING RESEARCHER — *Jan. 2016 - Jun. 2017*

- Acoustic Metamaterials and 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] Electric Field Guided Fabrication of Multi-Functional Sensors on Soft Surfaces. Purnendu, Madhur Atreya, Teis Hart, Gregory Whiting, Carson Bruns. *[Under preparation for Additive Manufacturing (Elsevier), 2023.]*

[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. *To appear as technical paper for IEEE World Haptics Conference (2023).*

[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*

[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.

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 California Los Angeles: Hosted by Qibing Pei, May 2023;
Title: Electrohydraulic Machines for Soft-matter Manipulation

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

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, Small Methods, Advanced Materials Technologies, Macromolecular Rapid Communications, Nano Select, Chemistry Select, Chemistry Open

Conferences: ACM CHI 2019, 2020, 2021; ACM DIS 2021

Awards and Honors

2023 **Graduate School international Travel Grant ,** ($ 700), University of Colorado Boulder
2022 **Beverly Sears Graduate Student Grant ,** University of Colorado Boulder
2021 **Outstanding Reviewer ,** ACM Conference on Designing Interactive Systems, 2021
2013-18 **Inspire Scholarship for Higher Education (SHE) ,** Ministry of Education, Govt. of India

Teaching Experience

FORM (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.

Mentoring

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

Maya Ledvina: Creative Industries Master's Student in Creative Technology and Design, University of Colorado Boulder

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

Marian Baldonado: Social Impact 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

Graduate Coursework

CU Boulder:

Haptic Interfaces, Design and Ananlysis of Algorithms, Natural Language Processing, Applied Machine Learning, Theory of Computation, Metamaterial Design Principles, Partial Differential Equations, Bio-inspired Multi-Agent Systems, Quantum Information and Computing

IIT Roorkee:

Advanced Condensed Matter Physics, Physics of Nanosystems, Physics and Technology of Thin Films, Advanced Characterization Techniques, Molecular Spectroscopy and Lasers

Skills

ADVANCE SKILLS in soft actuator design and development: Including Soft Lithography, Various methods of heat-sealing, and Elastomer Fabrication, as well as high-voltage (1kV-10 kV) circuit design and development.

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 electronic hardware design and assembly: 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

Carson J. Bruns
Assistant Professor, ATLAS Institute and Department of Mechanical Engineering, University of Colorado Boulder
E-mail: carson.bruns @colorado.edu

Mark D. Gross
Director, ATLAS Institute, and Professor, ATLAS Institute and Department of Computer Science, University of Colorado Boulder
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Gregory L. Whiting
Associate Professor, Department of Mechanical Engineering, University of Colorado Boulder
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