ANAND KUMAR MISHRA
Post-Doctoral Associate at *Cornell University*

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SUMMARY: Received a PhD in Biorobotics with honors. Scientific interests are bio-inspired soft robotics (especially plants, fungus, and biohybrid actuation and sensing), 3D printing technologies for building biomimetic soft robots, and agricultural and environmental soft robotics. Currently, working on multi sensor innervated, 3D printed soft gripper and worm-like robot for studying plant-soil interactions and biohybrid sensor for soil-health sensing.

EDUCATION

Jun 2018 — **Scuola Superiore Sant'Anna (SSSA), Pisa**, Italy
Doctor of Philosophy in Biorobotics (Cum Laude/Honors)
Supervisors: Dr. Barbara Mazzolai and Prof. Cecilia Laschi
Thesis: "Soft Robotic Technologies for Exploration and Manipulation Tasks"
Relevant tasks: Bio-inspired and biomimetic designs, plant-inspired robots, flexible fluidic actuators, modular continuum manipulator, soft gripper, stretchable soft sensors, hydrogel actuator, SLA 3D printing.

May 2014 — **Indian Institute of Technology Patna, Patna**, India
Master of Technology, **Mechatronics (Silver Medalist)**
Supervisor: Prof. Atul Thakur
- Thesis: "Design Simulation Planning and Fabrication of Bio-inspired Quadruped Robot"
- Relevant Courses: Modeling of mechatronics systems, mobile robotics, engineering mathematics

Jun 2012 — **Uttar Pradesh Technical University Lucknow**, India
Bachelor of Technology, **Mechanical**
Supervisor: Prof. Rohit Kumar Singh
- Thesis: "Design and Development of Hand Exoskeleton & Robotic Arm with Haptic Technology"
- Relevant courses: Design, kinematics, dynamics, control, thermal, material science, and manufacturing.

RESEARCH EXPERIENCES

Nov 18-Present — **Cornell University, MAE,** Organic Robotics Lab, **New York,** USA
Post-Doctoral Associate- Prof. Robert F. Shepherd
- *Fungal mycelium*: Investigating fungus for developing biohybrid solutions for sensing, signal transmission.
- *Multimodel sensor embodied 3D printed soft gripper*: Human centric soft gripper for fruit harvesting.
- *Worm-like soft-robotic endoscope*: Studying plant-soil interactions and soil monitoring to predict plant-soil health.
- *Waterbomb origami-based variable aperture antenna using 3D printed soft joint*
- *FEA modeling of stretchable 3D printed scaffold for proprioceptive and exteroceptive sensing*
- *Leaf sensing soft gripper*: Touch sensor innervated soft gripper for leaf stiffness measurement.
- *Viscous fluid interaction with bi-stable structure and haptic interface*: Develop haptic display for blind people using 3D printing, bistable principles, and viscous fluid.

Jul 17-Dec 17 — **Visiting PhD student Prof. Robert F. Shepherd**
- *Multi-material 3D printed hydrogel actuator*: Printed actuator can perspire and thermally regulate its body. It has thermo-responsive pores that change its pore size depending on the temperature.
- *Light guide sensor integrated foam actuator*: Develop a high impulse foam actuator integrated with a soft stretchable optical wave-guide sensor. It can measure the terrain contact force and actuator's curvature.

Jun 18-Oct 18 — **Istituto Italiano di Tecnologia (IIT),** CMBR**, Pisa**, Italy
Research Scientist-Dr. Barbara Mazzolai
- *Plant-inspired soft robot for exploration***:** Integrate plant-root-mechanisms in a growing robot.

- *Plant-inspired dry adhesive climbing robot*: Study and mimic the dry adhesion mechanism of *Galium aparine*.

Nov 14-Jun 18

Biorobotics Institute (SSSA) & Center for Micro Biorobotics (IIT), Pisa, Italy
PhD Fellow-Prof. Cecilia Laschi and Dr. Barbara Mazzolai

- *Plant-inspired robot*: Part of the European-funded project PLANTOID. Work was focused on studying plant roots' penetration capabilities in the soil. Specifically, mimicking root morphology, mucus exudation, sloughing of border cells, lateral and axial growth of cells, and develop a soft exploratory robot for exploration tasks.
- *Soft modular continuum manipulator (SIMBA)*: Soft intelligent manipulator for broad applications (SIMBA) was designed for grasping unknown objects, arm positioning, and door opening tasks. SIMBA is a compliant, conformable, and adaptable manipulator that can configure its finger position depending on object shape and functions adeptly in unstructured environments.

Jul 12-May 14

Indian Institute of Technology Patna, Patna, India
Research Assistant-Prof. Atul Thakur

- *Alligator-inspired quadruped robot*: Amphibious robot (terrestrial and aquatic locomotion both) inspired by alligator's anatomy, which can move on different terrains (rugged, flat) with a flexible spine.
- Snake-inspired robot: A six DOF snake robot with six modules implemented the serpentine gait to move it on a rugged surface.

Jun 13-Jan 14

Defense Research and Development Organization, CAIR, **Bangalore**, India
Visiting Master Student-Dr. Sartaj Singh

- *Mule-inspired quadruped robot*: The study includes the simulation and design of a mule-inspired quadruped robot. Design and synthesis of leg and whole body, gait planning, and robot modeling.

TEACHING AND ADVISING EXPERIENCES

Spring 22
Spring 21
Spring 19
Jan 19 to present

Cornell University, New York, USA
Guest lecture on MAE4630/4631/5360 course: Advanced Product Design
Guest lecture on MAE4630/4631/5360 course: Advanced Product Design
Guest lecture on ECE6970/VIEN4940 course: Robot, Food and Vine
Mentoring- Two undergrad students and four master students.

Feb 18 to Oct 18

Center for Micro Biorobotics (IIT), Pisa, Italy,
Mentored one PhD student.

Jul 14-Nov 14

National Institute of Technology Uttarakhand, Garhwal, India
Assistant Professor, Department of Mechanical Engineering

- Courses taught: Engineering drawing, thermodynamics, material science, and engineering design
- Mentoring- Two undergraduate students for the community project

Jul 12-May 14

Indian Institute of Technology, Patna, Patna, India
Teaching Fellow, Department of Mechanical Engineering

- Tutoring undergraduate and postgraduate students for engineering drawing lab, and mechatronics lab and mobile robotics course.
- Mentoring- four masters and 11 undergrad students for a mobile robotics project.

JOURNAL PUBLICATIONS

1. Jo, J., Xu, A., **Mishra, A.K.**, Bai, H., Derkevorkian, A., Rabinovitch, J., Park, H. and Shepherd, R.F., 2022. Measurement of Parachute Canopy Textile Deformation Using Mechanically Invisible Stretchable Lightguides. ***Advanced Materials Technologies***, p.2200437.
2. Kim, J*., **Mishra, A.K.***, Radi, L., Bashir, M.Z., Nocentini, O. and Cavallo, F., 2022. SurgGrip: a compliant 3D printed gripper for vision-based grasping of surgical thin instruments. Meccanica, pp.1-16.
3. **Mishra, A.K.**, Pan, W., Giannelis, E.P., Shepherd, R.F. and Wallin, T.J., 2021. Making bioinspired 3D-printed autonomic perspiring hydrogel actuators. ***Nature Protocols***, pp.1-20.
4. Shayak, B., Sharma, M.M., Gaur, M. and **Mishra, A.K.**, 2021. Impact of reproduction number on the multiwave spreading dynamics of COVID-19 with temporary immunity: A mathematical model. ***International Journal of Infectious Diseases***, 104, pp.649-654.

5. Karmakar, S. and **Mishra, A.**, 2021. Deployable SMA-Based Light Solar Sail Prototype. Advances in ***Astronautics Science and Technology***, pp.1-8.
6. **Mishra, A.K.**, Wallin, T.J., Pan, W., Xu, P., Wang, K., Giannelis, E.P., Mazzolai, B. and Shepherd, R.F., 2020. Autonomic perspiration in 3D-printed hydrogel actuators. ***Science Robotics***, 5(38). [**NSF's 4 Awesome discoveries**]
7. Peretz, O., **Mishra, A.K.**, Shepherd, R.F. and Gat, A.D., 2020. Underactuated fluidic control of a continuous multistable membrane. ***Proceedings of the National Academy of Sciences*** (***PNAS***), 117(10), pp.5217-5221.
8. Fiorello, I., Tricinci, O., Naselli, G.A., Mondini, A., Filippeschi, C., Tramacere, F., **Mishra, A.K.** and Mazzolai, B., 2020. Climbing Plant-Inspired Micropatterned Devices for Reversible Attachment. ***Advanced Functional Materials***, p.2003380.[**Featured cover art**]
9. Xu, P.A., **Mishra, A.K.**, Bai, H., Aubin, C.A., Zullo, L. and Shepherd, R.F., 2019. Optical lace for synthetic afferent neural networks. ***Science Robotics***, 4(34).
10. Kim, J*., **Mishra, A.K.***, Limosani, R., Scafuro, M., Cauli, N., Santos-Victor, J., Mazzolai, B., and Cavallo, F., 2019. Control strategies for cleaning robots in domestic applications: A comprehensive review. ***International Journal of Advanced Robotic Systems***, 16(4), p.1729881419857432.
11. **Mishra, A.K.**, Tramacere, F., Guarino, R., Pugno, N.M., and Mazzolai, B., 2018. A study on plant root apex morphology as a model for soft robots moving in soil. ***Plos One***, 13(6), p.e0197411.
12. **Mishra, A.K.**, Degl'Innocenti, A., and Mazzolai, B., 2018. Three-dimensional reconstruction of root shape in the moth orchid Phalaenopsis sp.: a biomimicry methodology for robotic applications. ***BMC research notes***, 11(1), p.258.
13. **Mishra, A.K.**, Mondini, A., Del Dottore, E., Sadeghi, A., Tramacere, F. and Mazzolai, B., 2018. Modular Continuum Manipulator: Analysis and Characterization of Its Basic Module. ***Biomimetics***, 3(1), p.3. [**Featured cover art**]
14. **Mishra, A.K.**, Del Dottore, E., Sadeghi, A., Mondini, A. and Mazzolai, B., 2017. SIMBA: Tendon-Driven Modular continuum arm with the soft reconfigurable gripper. ***Frontiers in Robotics and A.I.***, 4, p.4.
15. Sadeghi, A., Mondini, A., Del Dottore, E., **Mishra, A.K.**, and Mazzolai, B., 2016. Soft-legged Wheel-Based robot with Terrestrial locomotion abilities. Frontiers in Robotics and A.I., 3, p.73.
16. **Mishra, A. K.**, Kumar, R., & Sarangi, S., 2014. Mathematical Modeling of Electromagnetic Levitation Based Active Suspension using Bond Graph. ***Applied Mechanics and Materials*** (Vol. 575, pp. 785-789).
17. Shriyam, S., **Mishra, A.K.**, Nayak, D., & Thakur, A., 2014. Design, fabrication, and gait planning of alligator-inspired robots. ***International Journal of Current Engineering and Technology***, 567-575.

SELECTED CONFERENCE PROCEEDINGS

18. **Mishra, A.K.**, Wallin, T.J., and Shepherd, R.F., 2020, 3D printed Sweating Robots, MRS Spring 2021
19. Karmakar, S., Gaddam, V., Kim, J., **Mishra, A.K**. and Sarkar, A., 2021, June. Helical SMA Actuator based Artificial Muscle and Arm with Sliding Mode Control. ***In Advances in Robotics-5th International Conference of The Robotics Society*** (pp. 1-5).
20. Russo N.E., Zekios C.L., An H.S., **Mishra A.K.**, Shepherd, R.F., Georgakopoulos S.V., 2021. On the Design and Development of an Origami Multimode Ring Antenna, ***URSI***
21. Peretz, O., **Mishra A.K.**, Shepherd R.F., Gat A. D., Experiments, and analysis of viscous flows in bistable elastic channels, ***Bulletin of the American Physical Society*** **(2019)**, Washington, USA.
22. Peretz, O., Shepherd R.F., **Mishra A.K.**, Gat A. D., Transient Dynamics of Viscous Flow Interacting with Bi-stable Elastic Structures**, *Fluid and Elasticity*** (2019), Spain.
23. Visentin F.*, **Mishra A.K.***, Naselli G.A.*, Mazzolai B., Simplified Sensing and Control of a Plant-Inspired Cable-Driven Manipulator, ***IEEE Robosoft conference*** *(2019)*, South Korea.
24. Fiorello, I., Tricinci, O., **Mishra, A.K.,** Tramacere, F., Filippeschi, C. and Mazzolai, B. Artificial System Inspired by Climbing Mechanism of Galium Aparine Fabricated via 3D Laser Lithography. ***Conference on Biomimetic and Biohybrid Systems*** (2019), France.
25. **Mishra A.K.**, Tramacere F & Mazzolai B., From plant root's sloughing and radial expansion mechanisms to a soft probe for soil exploration, ***IEEE Robosoft conference*** *(2018)*, Italy.
26. **Mishra A.K.**, Raina R., Yadav S.B., Verma A., Saha A & Sarangi, S., Modeling and Simulation of Levitating Ball by Electromagnet using Bond Graph, ***1st International and 16th National Conference on Machines and Mechanisms*** *(2013)*, India.

PUBLICATIONS IN ARCHIVE AND PREPARATION

1. Shayak, B., Sharma, M.M. and **Mishra, A.K.**, 2021. Impact of immediate and preferential relaxation of social and travel restrictions for vaccinated people on the spreading dynamics of COVID-19: a model-based analysis. ***medRxiv***.

2. Shayak, B., Sharma, M.M. and **Mishra, A.K.**, 2021. COVID-19 Spreading dynamics in an age-structured population with selective relaxation of restrictions for vaccinated individuals: a mathematical modeling study. ***medRxiv***.

PRESENTATIONS

- **Bioinspired 3D printed Sweating Robots,** ***CCMR*** Materials Symposium 2021
- **3D printed Sweating Robots**, ***MRS*** Spring 2021
- **Biomimetic and Bioinspired Soft Robots: How Nature Teaches Us Sustainable Innovation, Syracuse University, (2021) [Invited Lecture series** in the Department Mechanical Engineering**]**
- **From Plant Root's Sloughing and Radial Expansion Mechanisms to a Soft Probe for Soil Exploration,** IEEE Robosoft conference (2018)
- **Centimeter to Millimeter Scale Actuators,** Celebrazioni di San Faustino, Italy, 2015
- **Sloughing based Design, a Soft Robotic Tip for Effective Soil Penetration,** soft robotics week, Italy, 2015
- **Mammal-inspired Quadruped Robot**, University of Belfield, Germany, 2014 [**Invited talk**]
- **Multidisciplinary Design Methodology and Fabrication of Alligator-Inspired Robot**, IIT Patna, 2014

HONORS AND AWARDS

Cornell University, New York, USA

Jul 21 Rootscan Challenge by Bayer Pharmaceuticals and Life Sciences (**3rd Position globally**)
Mar 20 Autonomic perspiration in 3D-printed hydrogel actuator paper listed as **4 Awesome Discoveries** by ***National Science Foundation***, USA
Feb 20 Received the **Best Scientist** award by Institute of Technical and Scientific Research, India
Jul 17-Dec 17 Received **fall semester fellowship** from the College of Engineering (MAE)

Scuola Superiore Sant'Anna, Pisa, Italy

Sept 2018 • **Best PhD thesis award** (Premi di Dottorato) by National Group of Bioengineering (GNB), Italy
Nov 14-Nov 17 • Received **full PhD fellowship** by Istituto Italiano di Tecnologia@SSSA, Italy

Indian Institute of Technology Patna, Patna, India

Aug 15 • Institute Silver Medal for **Best Academic Performance** in master's program
Aug 15 • Institute Proficiency Prize for **Best Postgraduate Thesis** in master's program
May 14 • **Travel grant** by Indian National Academy of Engineering (INEA), Govt. of India
Jul 12-May 14 • Postgraduate fellowship by Government of India
2011 & 2012 • Qualified Graduate Aptitude Test (GATE)

Uttar Pradesh Technical University, Lucknow, India

Jun 12 • Institute Silver Medal for Best Undergraduate Thesis award
Aug 08-May 12 • Undergraduate fellowship by State Government of Uttar Pradesh, India
Feb 09 • Best volunteer award in cultural fest
Jan 09- Jan 12 • Received prizes in **International and National Level Technical Events**

GRANT WRITING EXPERIENCES

Cornell University

- **CROPPS**: A National Science Foundation Science and Technology Center with $25M grant over 5 years. Involved in this program as a trainee to explore new ideas for future plant communication, and sensing and write short grants.
  1. *Quantifying Soil Health by Probing the Electrophysiology of Mycorhizzal Networks (Primary trainee)*
  2. *Robotic I/O for Roots and Leaves (Secondary trainee)*
- **NIFA-USDA: NRI:** Ubiquitous soil sampling robots for confluent soil monitoring
  Sponsor: National Science Foundation (NSF)
  P.I.: Prof. Robert Shepherd, Cornell University
- **SitS NSF**- Field deployable sensing of the plant-soil interface: innovative bio-mimetic robots to understand dynamic soil processes and accelerate root and rhizosphere productivity.
  Sponsor: National Science Foundation (NSF)
  Co-PI: Prof. Robert Shepherd, Cornell University
- **CIDA: StraBot:** a Soft, dexterous soft manipulator with hybrid sensing for strawberry harvesting and monitoring (2020-2022) (**150k $**)
  Sponsor: Cornell Initiative for Digital Agricultural (CIDA)

Istituto Italiano di Tecnologia	P.I.: Prof. Robert Shepherd, Cornell University • **CIDA SoilBot:** New soil robotics and sensing for soil-root phenotyping of water-use effectiveness (2019-2020) (**300k $**) Sponsor: Cornell Initiative for Digital Agricultural (CIDA) Co-PI: Prof. Robert Shepherd, Cornell University • **SMASH**- Smart Machines for Agricultural Solutions Hightech (2018-2020) Sponsor: Regione Toscana -PorCReOFESR (**200k €)** PI: Barbara Mazzolai • **GrowBot**- Towards a new generation of plant-inspired growing artifacts (2019-2023) Sponsor: FET Proactive: emerging paradigms and communities, Horizon 2020, European Union (**7M €)** P.I.: Barbara Mazzolai

LEADERSHIP EXPERIENCES

Aug 22	Member of **Trainee Leadership Council (TLC) in** Center for Research on Programmable Plant Systems **(CROPPS), Cornell.**
Apr 21	**Organizing chair** of the workshop on *Agricultural soft robotics* (**IEEE RoboSoft, 2021)**
Apr 16	**Team leader** for Soft Robotics Challenge in Manipulation Task, IEEE Robosoft conference.
Mar 2015	Pitched startup idea "DigTech: *Plant-inspired Probe for Sustainable Fracking for Oil and Gas Industry*."
Dec 09-Dec 11	**Assistant coordinator** and **coordinator** for culture festival Abhivyakti.
Aug 09-Dec 11	**Coordinator** and **mentor** for robotics club Grobot.
09, 10, 11	**Team leader** for several international robotics challenges to represent institute robotics club.

REVIEWER AND EDITORIAL EXPERIENCES

From 23	**Topic Editor on** Bioinspired Robotics at Small-Scale: From 3D Micro-Fabrication to Bio-Hybrid Materials of **Frontiers in Robotics & AI**.
From 23	**Guest Associate Editor** of Bioinspired Soft Robotics, **Frontiers in Robotics & AI.**
From 21	**Editorial Board Member** of **Bionics *and Biomimetics*** section of **Frontiers in Bioengineering & Biotechnology, and Robotics & AI.**
From 21	**Guest Editor** of a Special Issue on **Soft Robotics** by ***Royal Society of Chemical (RSC)***, Soft Matter
From 21	Reviewer of Tayler and Francis publishing group**, Advanced Robotics**
From 21	**Review Board member** for *Actuators Journal* (MDPI Publishing)
From 20	**Topic Editor** for *Sensors Journal* (MDPI Publishing) Reviewer of Science Publishing, **Science Robotics** Reviewer of ASME journals: Journal of mechanical design.
From 18	Reviewer of MDPI journals: Applied sciences, Electronics, Robotics, Sensors, Actuator, Philosophies, and International Journal of Environmental Research and Public Health (> 30 journals).
From 14	Reviewer of IEEE conferences and Journals (**Transaction Robotics (TRO)**, **Robotics Automation Letter (RAL)**, ICRA, IROS, RoboSoft, AIM, and CoDIT, > 20 journals and conferences).

MEMBERSHIPS

From 21	Material Research Society (MRS)
From 19	The New York Academy of Sciences, National Postdoc Association.
From 14	IEEE member, Robotics and automation society, IEEE sensors council, young professional, IEEE systems council.

SCHOOLS &WORKSHOPS

	Cornell University, New York, USA
Sept 20 to - Spring 21	Next-Gen Professor Program Online Learning Institute Program
Spring 21	Teaching Portfolio Institute Program
Spring 21	Course Design Institute Program
Oct 19 to Mar 20	Postdoc Leadership Program
Jan 20 to Apr 20	Building Mentorship Skills for Academic Careers
Dec 19	P2S: Pathways to success, A Professional Development Symposium

Oct 19	3rd Annual CIDA Digital Agriculture Workshop
Jul 19	How to Submit Grants at Cornell – A Primer for Postdocs.
29-30 Apr 16 13-17 Apr 15 Nov 14- Mar 15	**Scuola Superiore Sant'Anna,** Pisa, Italy • Soft Robotic Grand Challenges, Livorno, Italy: Participated in the soft robotic challenge for terrestrial and manipulation tasks. • SMART-E & Robosoft Joint School, Livorno, Italy: Attended spring school: Application and Frontiers of Soft Robotics. • Attended the "High-Tech business venturing" course by Tuscan StartUP Academy, Italy.
Mar 13 Apr 13 Mar 13 Jan 13 Nov 12	**Indian Institute of Technology Patna,** Patna, India • Patent and IPR workshop by IIT Patna. • High-performance computing and smart buildings by IBM. • Adams, Patran and Nastran software workshop by MSC software. • LabView training workshop by National Instruments (N.I.).
Oct 09	**Uttar Pradesh Technical University,** Lucknow, India • Haptic Technology by Technofilia.

INDUSTRY EXPERIENCES

Jun 11-Jul 11	**Central Institute of Plastic Engineering and Technology,** Lucknow, India Summer intern: Different plastic manufacturing techniques for daily life products.
Jun 10-Oct 10	**CADD Center,** Lucknow, India CAD trainee: For Pro\E & AutoCAD design software.
Jun 10-Jul 10	**Hindustan Aeronautics Limited,** Lucknow, India Summer intern: Flexible manufacturing and automation systems in the aircraft industry.
Jun 09-Jul 09	**Brics, Indian Institute of Technology Kanpur,** Kanpur, India Summer intern: Embedded System, PCB Design, Automation.

MEDIA ATTENTIONS

- Soil-Swimming Wormbot project was reported by several online and offline media and magazines such as **Cornell Chronicle**, **NewsAtlas**, **Interesting Engineering**, **InceptiveMinds**, **AgWeb**, etc.
- Autonomic perspiration in 3D-printed hydrogel actuators paper was reported ***66 News Outlets*** such as in **Forbes**, **CNN**, **IEEE Spectrum**, **Science Daily**, **TechXplore**, **Cornell Chronicle**, **Google News**, **Nanowerk**, **Laboratory Equipment**, **Scinexx**, **The Engineer**, T**he guardian, Scientific American,** etc.
- Ten news outlets reported optical Lace for Synthetic Afferent Neural Networks paper: **Cornell Chronicle**, **Physics World**, S**cience Daily**, M**ail Online**, **TechXplore**, etc.
- SIMBA: Tendon-Driven Modular continuum arm with the soft reconfigurable gripper paper was reported on **wevolver.com** and local Italian news media.
- Soft-legged Wheel-Based robot with Terrestrial locomotion abilities was reported in **wevolver.com**