DEVELOPMENT OF BIO-INSPIRED ROBOTS

Stephen J.A.

***Scientific adviser**: Sobirjonov A.Z.*
Senior lecturer of the Department of biomedical engineering, computer science and biophysics
Tashkent Medical Academy, Tashkent, Uzbekistan

Abstract: The development of bio-inspired robots is a captivating and rapidly advancing field within robotics and bioengineering. Researchers are increasingly turning to nature for inspiration in designing robots that mimic the structure, movement, and functionality of living organisms. By emulating biological systems, these robots aim to achieve enhanced efficiency, adaptability, and interaction capabilities. Bio-inspired robots are being developed to navigate complex terrains, perform delicate tasks, and even interact with living organisms, showing promise in applications ranging from healthcare to environmental monitoring. This abstract provides an overview of the current trends and advancements in the development of bio-inspired robots, highlighting their potential to revolutionize various industries and improve the quality of human life.

Keywords: *Robotics, Biological System, Living organism, Healthcare, Human life*

Main part: Robots are intended to be able to adapt to unpredictable, dynamic, and unstructured surroundings by imitating natural animals. It is necessary for us to emulate or outperform biological systems with hierarchical structures in order to develop bio-inspired robots: Organs are subordinate to the body as a whole, tissues are subordinate to cells, and cells are subordinate to tissues. A cell can even be examined in further detail and treated as a sophisticated subsystem. Typically, the process of creating bio-inspired robots begins with studying the habits of animals. Next, mechanical structures and artificial actuators are used to mimic the actions of muscles and bones. Though their functions are comparable to those of organic tissues and organs, these artificial components may differ greatly in terms of their construction, material composition, and operating principles. The development of appropriate controllers enables the robot to produce the appropriate behavior at the appropriate time by controlling the motion of the actuators in response to sensor feedback. We use two approaches to the creation of bioinspired robots for conservation. Initially, the operational factors that direct its development to guarantee its durability, sustainability, and applicability in field operations. Second, the environmental factors that affect how robots interact with their surroundings and are determined by characteristics unique to terrestrial, aerial, and aquatic habitats. Conservation initiatives are essential to halting the planet's declining health. From this vantage point, we talk about the creation of bioinspired robots as adaptable tools that can greatly increase the reach and efficacy of global conservation initiatives while reducing adverse effects on living things and the natural state of the environment. The development of unique capabilities that mimic the movements, senses, and interactions of animals in the natural world is necessary to bring about the day when bioinspired robots can carry out conservation activities such as exploration, data collection, intervention, and maintenance. By co-evolving the morphology, actuation, control, and sensing of physical systems, it is possible to endow them with the capacity to carry out tasks analogous to those of intelligent beings. This is known as physical artificial intelligence. But the creation of robots that can mimic animals won't be enough to enable their broad and successful application in conservation initiatives down the road. Here, we offer further robot-related issues, such as the robot's suitability as interactive conservation agents, its practicality in research and field operations, and its interdisciplinary research collaboration. From this point of view, we offer a framework that could transform global conservation efforts by enabling researchers to create bioinspired robots with animal-like capacities. These robots can perform ecological field missions, provide extensive, standardized, and repeatable data collection and monitoring, and perform precise and efficient intervention and maintenance tasks. They can also provide sustainable and effective means of exploring unexplored environments. In summary, biological systems have a number of advantages due to their sensitive actuators, delicate sensing units, delicate control architectures, and delicate epidermal structures. To close the gap with their biological counterparts, future bioinspired robots should have similar delicate structures in both hardware and software. However, the current insurmountable obstacles in design, material synthesis, and fabrication make it impossible to faithfully replicate every intricate element of the biological system by synthetic means. As such, we have to omit delicate structures that don't matter or only slightly affect the performances or functions we use. This necessitates a thorough comprehension of the intricate workings of these delicate structures as well as the interactions between them and the system as a whole.

Literature:

Autumn, K., Liang, Y. A., Hsieh, S. T., Zesch, W., Chan, W. P., Kenny, T. W., et al. (2000). Adhesive force of a single gecko foot-hair. *Nature* 405 (6787), 681–685. doi:10.1038/35015073

Blum, K. P., Versteeg, C., Sombeck, J., Chowdhury, R. H., and Miller, L. E. (2021). “Proprioception: A sense to facilitate action,” in *Somatosensory feedback for neuroprosthetics* (Amsterdam, Netherlands: Elsevier), 41–76

Ghez, C., Gordon, J., Ghilardi, M. F., Christakos, C. N., and Cooper, S. E. (1990). Roles of proprioceptive input in the programming of arm trajectories. *Cold Spring Harb. Symp. Quant. Biol.* 55, 837–847. doi:10.1101/sqb.1990.055.01.079

Gilpin, W., Prakash, V. N., and Prakash, M. (2017). Vortex arrays and ciliary tangles underlie the feeding-swimming trade-off in starfish larvae. *Nat. Phys.* 13 (4), 380–386. doi:10.1038/Nphys3981

Hanson, J. (1957). The structure of the smooth muscle fibres in the body wall of the Earth worm. *J. Biophys. Biochem. Cytol.* 3 (1), 111–122. doi:10.1083/jcb.3.1.111

Bellicoso, C. D., Bjelonic, M., Wellhausen, L., Holtmann, K., Günther, F., Tranzatto, M., et al. (2018). Advances in real-world applications for legged robots. *J. Field Robotics* 35, 1311–1326. doi:10.1002/rob.21839

Amelia, T. S. M., Khalik, W. M. A. W. M., Ong, M. C., Shao, Y. T., Pan, H. J., and Bhubalan, K. (2021). Marine microplastics as vectors of major ocean pollutants and its hazards to the marine ecosystem and humans. *Prog. Earth Planet. Sci.* 8, 12–26. doi:10.1186/s40645-020-00405-4

Aubin, C. A., Choudhury, S., Jerch, R., Archer, L. A., Pikul, J. H., and Shepherd, R. F. (2019). Electrolytic vascular systems for energy-dense robots. *Nature* 571, 51–57. doi:10.1038/s41586-019-1313-1

Bicer, M., Phillips, A. T., Melis, A., McGregor, A. H., and Modenese, L. (2022). Generative deep learning applied to biomechanics: A new augmentation technique for motion capture datasets. *J. Biomechanics* 144, 111301. doi:10.1016/j.jbiomech.2022.111301

Blender, T., Buchner, T., Fernandez, B., Pichlmaier, B., and Schlegel, C. (2016). "Managing a mobile agricultural robot swarm for a seeding task," in IECON 2016-42nd Annual Conference of the IEEE Industrial Electronics Society, Florence, Italy, 23-26 October 2016 (IEEE), 6879–6886. doi:10.1109/IECON.2016.7793638