Blending Human Design with AI:
The Next Frontier in Bionic Robotics

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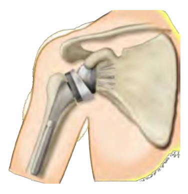
Background

Unifying humanoid robotics with AI, this initiative seeks to materialise artificial intelligence, empowering it to engage with the human world. Through meticulous scientific study of human soft tissues, our endeavour is to engineer robots that echo the intricate design of the human musculoskeletal system. We strive to elevate AI beyond virtual confines, equipping it with the hardware to learn and evolve in a manner akin to humans.

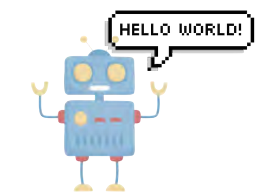
The MCR-Robot, our prototype, embodies this quest. With aspirations of exacting replication of human anatomy—from bones, cartilage, ligaments, joint capsules and tendons to skin—we aim to infuse the robot with control strategies that mirror the innate intricacies of human movement and interaction.

Applications

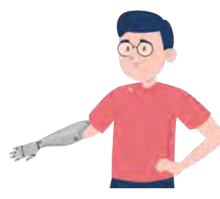
Testing biomimetic materials and sensors, overcoming ethical limits of human trials [5].



Facilitate surgical planning.



Serves as a platform for refining AI algorithms.



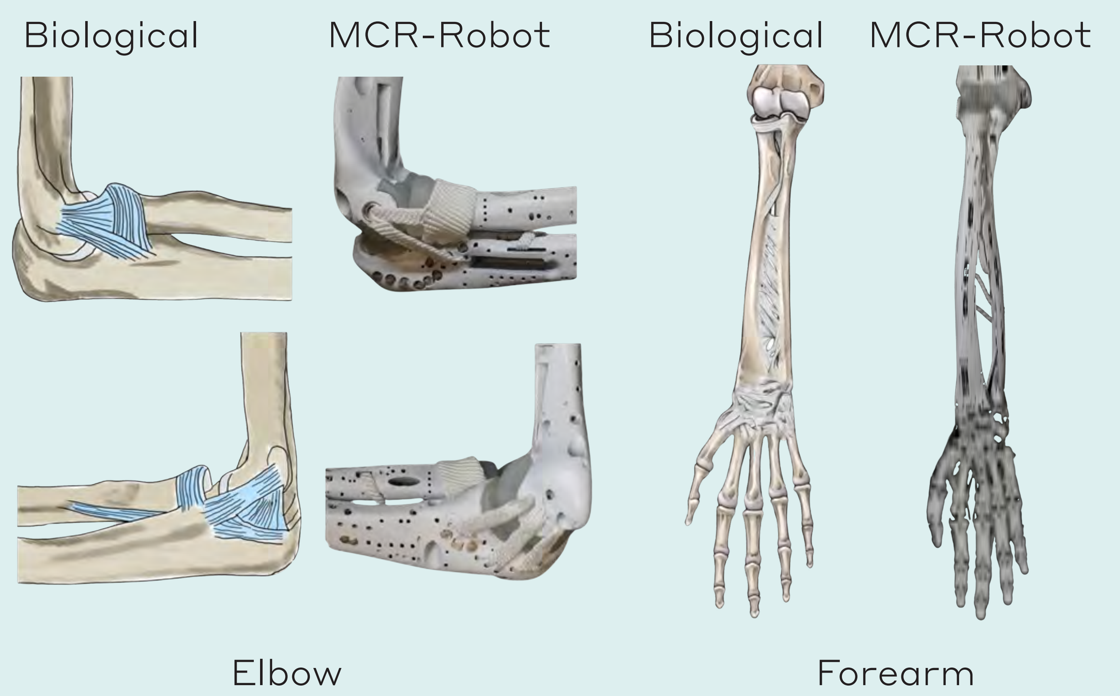
Provide prosthetics for individuals with disabilities.

Enable medical training experiments.

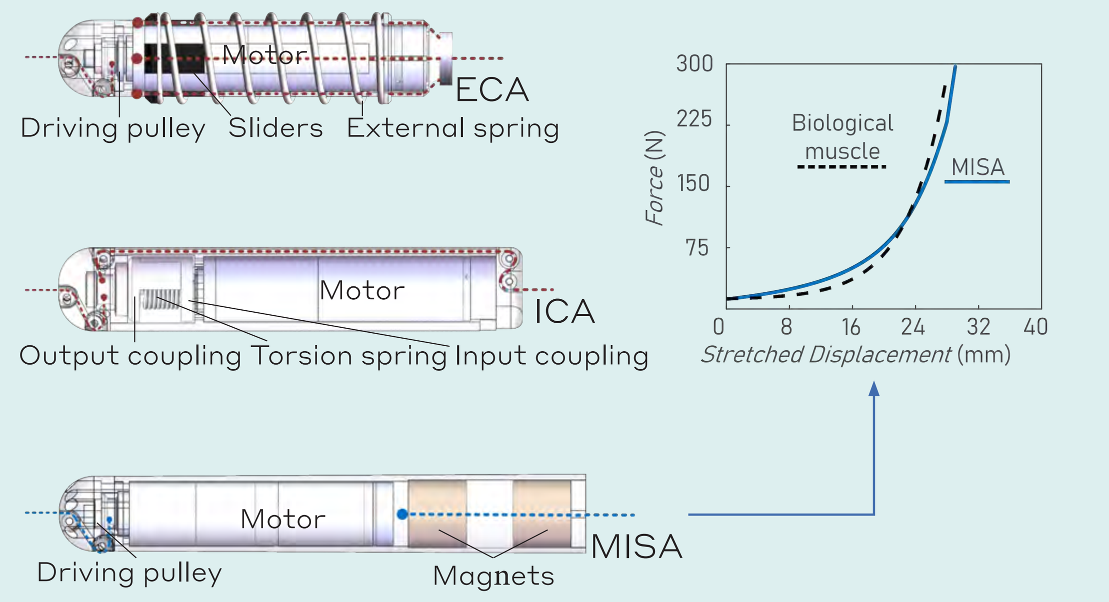
Serve as a versatile home service robot.

Biomechanical Intelligence in the MCR-Robot Mark I

Robotic joints mirroring the biological skeletal and ligament system [1]

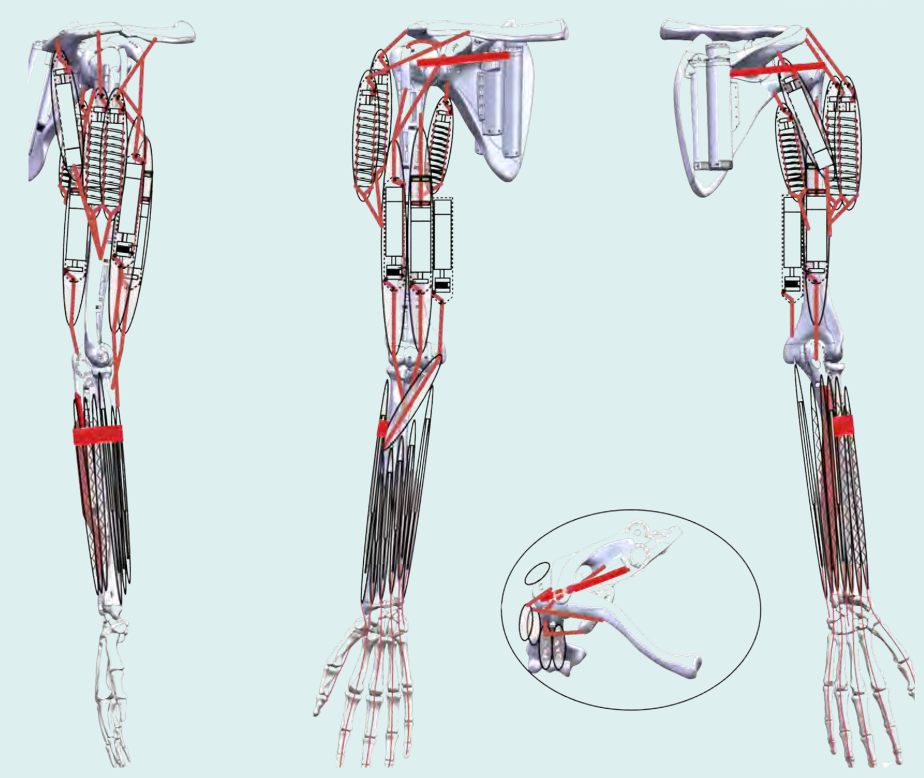


Three biomimetic soft muscles emulate biological muscle performance [3]

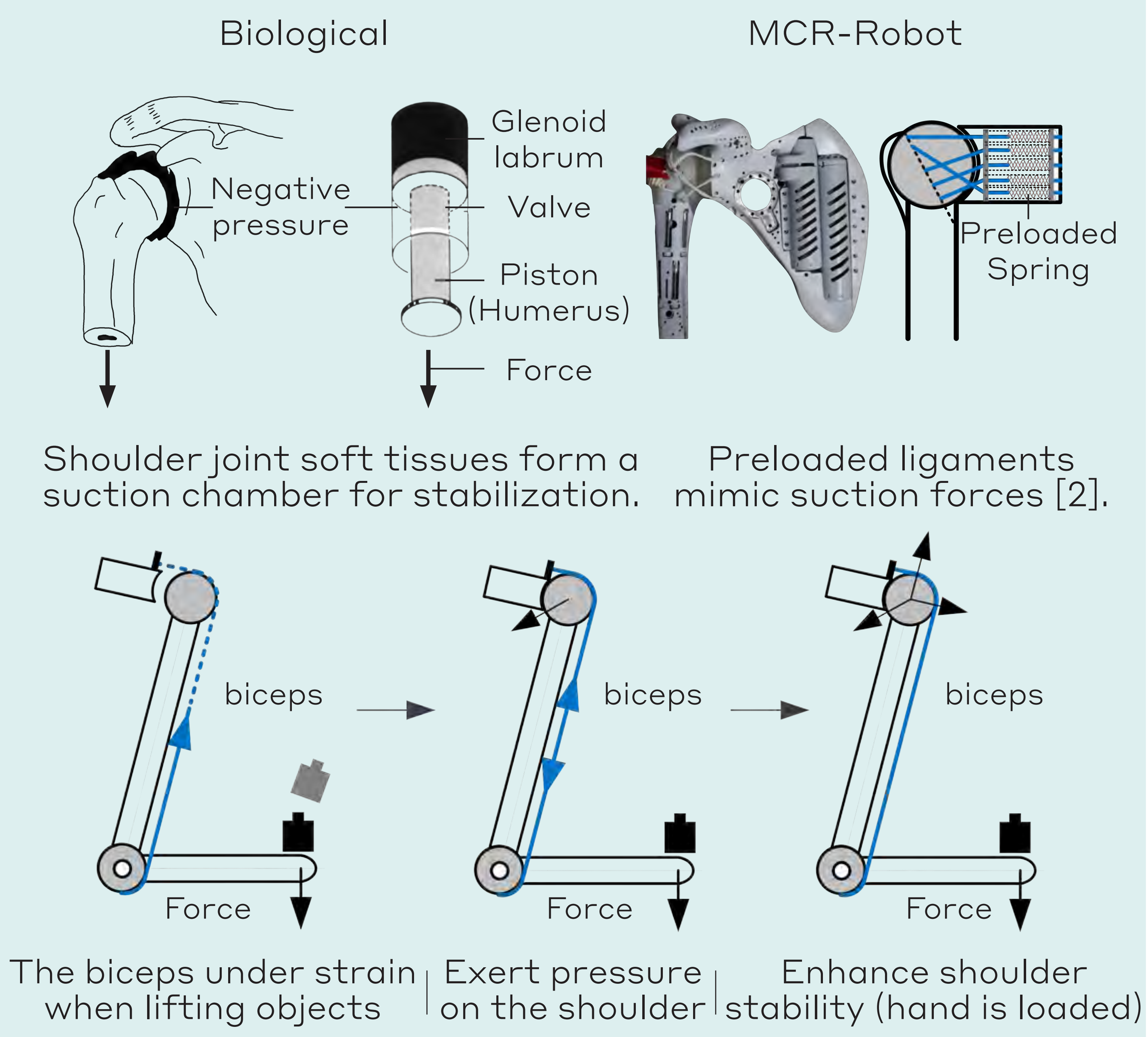


MISA's design leverages sharply increasing magnet repulsion with decreasing distance to achieve variable stiffness [4].

Biological muscle configuration replicated in robotic design [3]



Soft tissues stabilize the bionic shoulder joint without rigid axes [2]



Advantages of the MCR-Robot

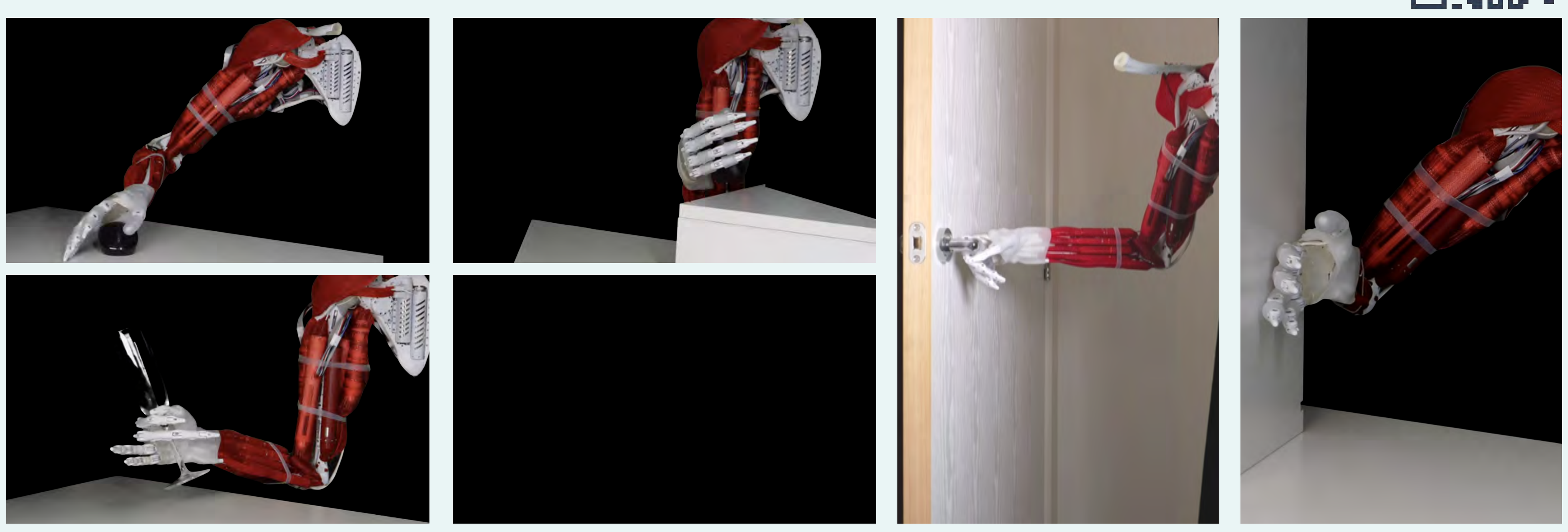
Compact
Achieves dexterity and high output with ultra-compactness akin to the human arm.

Bionic
Replicating the human arm's appearance , for seamless domestic service.

Safe
Bionic joints lack rigid axes for safer human-robot interactions, featuring dislocation and reorientation.

Stable
Soft tissue enhances joint stability and introduces damping to prevent wobble.

Performance demonstration of MCR-Robot



[1] H Yang, G Wei, L Ren. Enhancing the Performance of a Biomimetic Robotic Elbow-and-Forearm System Through Bionics-Inspired Optimization.
[2] H Yang, G Wei, L Ren. Development and Characteristics of a Highly Biomimetic Robotic Shoulder Inspired by Musculoskeletal Mechanical Intelligence.
[3] H Yang, G Wei, L Ren. Compliant actuators that mimic biological muscle performance with applications in a highly biomimetic robotic arm.
[4] H Yang, G Wei, L Ren. A Novel Soft Actuator: MISA and Its Application on the Biomimetic Robotic Arm. RA-L, 2023.
[5] L Chen, M Lu, H Yang. Textile-based capacitive sensor for physical rehabilitation via surface topological modification. ACS nano, 2020.

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