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Editorial

Special Issue on Advances in Bio-Inspired Robots

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Bio-inspiration is a good starting point of designing innovative mechanical systems, including robots. Additionally, it is a good way to solve engineering design and control problems. Recently, creative design has become very important in the robotics field, not just following previous design solutions but also suggesting novel system designs for various tasks. Bio-inspiration is becoming more and more popular in order to obtain innovative solutions inspired by animals and insects.

In this Special Issue, nine excellent papers are published on advances in bio-inspired robots. The papers are categorized into three groups as follows:

A. Biomimetic robot design
B. Mechanical system design from bio-inspiration
C. Bio-inspired analysis on a mechanical system

The detail contents can be summarized as follows.

1. Biomimetic Robot Design

1.1. Soft Jumping Robot Using Soft Morphing and the Yield Point of Magnetic Force

Soft-morphing, deformation control by fabric structures and soft-jumping mechanisms using magnetic yield points are studied. The soft jumping mechanism can transfer energy more efficiently and stably using an energy storage and release mechanism and the rounded ankle structure designed using soft morphing [1].

1.2. Snake Robot with Driving Assistant Mechanism

A driving assistant mechanism is proposed for a snake robot, which assists locomotion without additional driving algorithms and sensors. The driving assistant mechanism can prevent roll down on a slope and can increase the locomotion speed [2].

1.3. A Miniature Flapping Mechanism Using an Origami-Based Spherical Six-Bar Pattern

A novel transmission is proposed for DC motor-based flapping-wing micro aerial vehicles. The proposed origami-based fabrication method reduces the number of relative moving components by replacing rigid links and pin joints with facets and folding joints, which shortens the assembly process and reduces friction between components [3].

2. Mechanical System Design from Bio-Inspiration

2.1. Bioinspired Divide-and-Conquer Design Methodology for a Multifunctional Contour of a Curved Lever

Bioinspired design methodology for a multifunctional lever is proposed based on the morphological principle of the lever mechanism in the Salvia pratensis flower. Four partial contours are designed to satisfy three types of functional requirements. The final design for the lever contour is manufactured and verified with visual measurement experiments [4].

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2.2. Cable Tension Analysis Oriented the Enhanced Stiffness of a 3-DOF Joint Module of a Modular Cable-Driven Human-Like Robotic Arm

Inspired by the structure of human arms, a modular cable-driven human-like robotic arm is developed for safe human–robot interaction. Due to the unilateral driving properties of the cables, the robotic arm is redundantly actuated and its stiffness can be adjusted by regulating the cable tensions [5].

2.3. A Novel Type of Wall-Climbing Robot with a Gear Transmission System Arm and Adhere Mechanism Inspired by Cicada and Gecko

A novel type of wall-climbing robot is proposed with a new gear transmission system arm and an adherence mechanism inspired by cicadas and geckos. The adherence force experiments demonstrate that the bionic spines and bionic materials achieved good climbing on cloth, stone, and glass surfaces [6].

3. Bio-Inspired Analysis on A Mechanical System

3.1. Control Strategy for Direct Teaching of Non-Mechanical Remote Center Motion of Surgical Assistant Robot with Force/Torque Sensor

A control strategy is proposed from bio-inspiration that secures both the precision and manipulation sensitivity of remote center motion with direct teaching for a surgical assistant robot. Instead of the bulky mechanically constrained remote center motion mechanism, a conventional collaborative robot is used to mimic the wrist movement of a scrub nurse [7].

3.2. Empirical Modeling of Two-Degree-of-Freedom Azimuth Underwater Thruster Using a Signal Compression Method

Empirical modeling of a two-degree-of-freedom (DoF) azimuth thruster is presented based on bio-inspiration using the signal compression method. Empirical models of force and moment for rotational motion were derived for practical use through frequency analysis [8].

3.3. Energy-Efficient Hip Joint Offsets in Humanoid Robot via Taguchi Method and Bio-Inspired Analysis

The offsets of hip joints in humanoid robots are optimized via the Taguchi method to maximize energy efficiency. Through two optimization stages, near-optimal results are obtained for small power consumption [9].

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