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PROSPECTS FOR USING BIPEDAL ROBOTS

Анотація. Двоногі роботи розробляються вченими для покращення життєвих умов. Приклади відносно досягнень у цій галузі пояснюють, як саме подібні роботи можуть стати в нагоді людству.

Abstract. Bipedal robots are developed by scientists to improve life conditions. The examples illustrate how bipedal robots can benefit mankind.

Key words: *bipedal robot, locomotion, “spring - mass”, balance, ATRIAS, Cassie, Mercury, LEONARDO, flying and walking locomotion.*

Introduction. Nowadays, artificial intelligence devices are widely used. Since working in the extreme environment could cause huge damage to a person`s health, the researchers invented the applications to substitute people in hazardous areas, especially when it comes to the fire rescue operations, toxic gases or chemicals.

As a rule, people take walking process for granted. However, in reality, it is not that simple. Before we take a step, the nerves send signal to the brain to define the essential parameters which enable the brain to do the number of calculations, so the

human could stay upright [1]. The bipedal robots` movements are based on that principle.

Bipedal robots have two legs. The difference between them and other robots is that bipedal robots have bipedal locomotion. The main feature of bipedal robot structure is that they have the bodies with simple kinematic connections, in contrast to human beings [2]. That enables bipedal robots to do all the complicated tasks. Being a kind of humanoid robot, a bipedal robot performs the actions just like a human being: walking forward and backward, kicking, jumping, rolling over from left and right, so to be able to overcome obstacles in case of the complex terrain.

The history of bipedal robots begins in the late 60-s, when a walking robot Reg was constructed at General Motors (the USA) [3]. The most significant achievements in this development could be illustrated with LOLA (Germany), NAO (France), ASIMO (Japan), HUBO (South Korea), KHR – 2 (Japan) etc. The bipedal robotics companies are concentrated in Japan, South Korea, China, the USA, EU. Moreover, the top ones are "Honda", "Boston Dynamics", "PAL Robotics", and "Agility robotics" [1].

'Spring – mass' technology. A new technology named 'spring – mass' was developed by Oregon State University in 2015 [4]. The study shows the way how human-like walking could be reached for bipedal robots. This ability allows to react to rough terrain rapidly, so a bipedal robot is capable of balancing regardless of terrain.

For instance, designed in Oregon University, robot ATRIAS (fig.1a) that is as tall as a man can move over any bumpy surface saving balance. After that, the next generation of ATRIAS, robot Cassie (fig.1b) was created in 2017 [5]. Unlike ATRIAS, Cassie has much less weight and it is capable of being used outdoors even when it rains and snows.

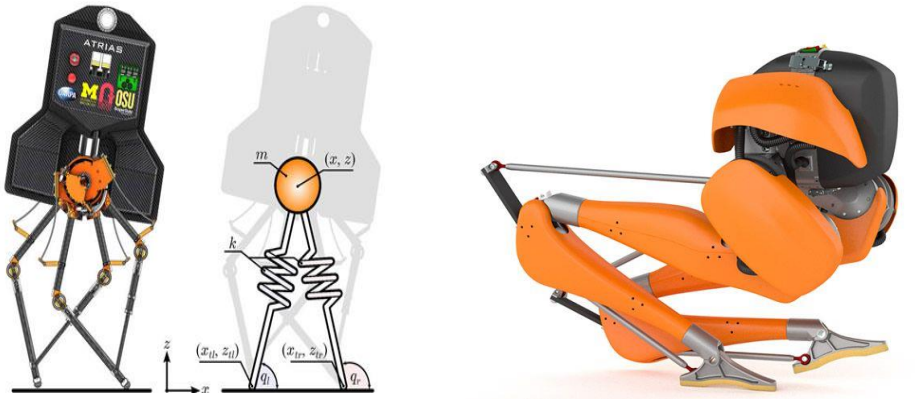
Furthermore, the technology of "spring - mass" could be integrated to produce bipedal robots that would assist the fire brigade to take out people from the fire, work in the military sphere, do household chores, replace staff in hotels and restaurants in the future.

Balance in a crowded area. The team of the University of Texas at Austin studied how a robot can balance in a crowded area [8]. They examined the bipedal robot Mercury (fig.2) to calculate the numerical value when a human falls down. The research led to inventing the equation which became fundamental for the method that allows robots to maintain balance, even in case of unexpected hit. That is most meaningful for further human locomotion developing, as the equation is appropriate for artificial intelligence research.

Flying and walking locomotion. Fig.3 demonstrates a bipedal robot named LEONARDO (or LEO for short). It was introduced to the public by the group of scientists of California Institute of Technology Center for Autonomous Systems and Technologies in the third quarter of 2021 [10]. This is the first robot that combines both flying and walking locomotion.

The inventors found inspiration in the movements of birds, especially in their ability to combine walking and flying.

LEO has a pair of multi-joint legs for bipedal walking and propeller thrusters. When walking, people change the position of their legs, so the center of mass moves forward, and they save the balance. LEO moves almost the same way.



(a) (b)

Fig.1. Bipedal robots ATRIAS (a) and Cassie (b) [6, 7]

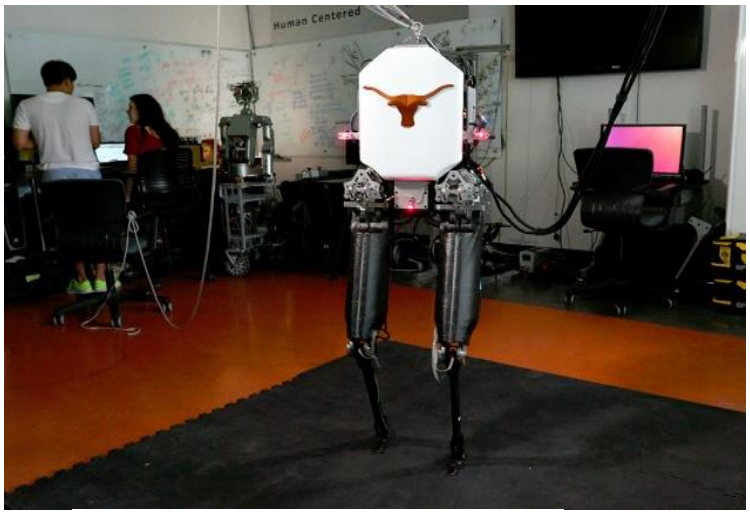


Fig.2. Bipedal robot Mercury [9]

Fig.3. Bipedal robot LEONARDO [11]

Besides, bipedal robots are made of aluminum sheet brackets with 1 mm thickness that makes such applications light [12]. The propellers implement the vertical state of the robot, and the foot actuators ensure changing the position of the legs. That represents locomotion between walking and flying.

On the one hand, bipedal robots like LEONARDO can be used for exploring landscape in the extreme conditions like deserts, rainforest, mines. Owing to the flying capacity, it is able to fly over dunes, swamps etc. The drones are also able to do the same thing, but the point is that high energy consumption does not allow them to travel a long distance.

On the other hand, the elements of walking and flying locomotion are predicted to be integrated into Mars rotorcraft that would reduce the risk of failure under challenging landscape. Thus, in the future such robots will be able to research planets that have hard soil.

Conclusion. Bipedal robotics are among the most prospective trends in the field of artificial intelligence. Researchers are convinced that bipedal robots would be particularly useful, if a human-like machine was demanded for comfortable interaction in medicine, defense, delivering and other areas.

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CREATING USING THE MATHCAD SYSTEM OF LABORATORY EXPERIMENTATION ON THE SUBJECT «INTELLIGENT DATA ANALYSIS»

Annotation. Methodical recommendation for laboratory experimentation on the subject of "Intelligent Data Analysis", based on the MathCAD system, will be briefly described. The experimentation for each laboratory research corresponds to open-source code, transparently related to mathematical models on the topic of the work. The developed experimentation consists of 6 research variations. Input data for each research has 32 options.

Keywords: *intelligent data analysis, mathematical statistics, random values, probabilistic distributions, point and interval estimates, correlation, regression, cluster.*

Introduction. Currently, in the training of IT specialists, one of the main educational components of the professional constituent is the subject "Intelligent Data Analysis". Known approaches to the organization of laboratory experimentation, in this subject, are based on the use of analytical platforms such as WEKA [1, 2] and Deductor Academic [3].

These products are powerful tools for solving practical Data Mining tasks, but they mostly use tools of intelligent data analysis as "black boxes". In addition,