Победителем игры становиться тот, кто заработал максимальное количество баллов.

В игре может участвовать неограниченное число участников. Для удобства обучения лучше формировать группу из 5-7 человек. Для адекватного и правильного оценивания ответов игроков назначается беспристрастный судья, который обосновывает выставленные баллы, анализирует ошибки и неточности при ответах. Как правило, судьей должен быть назначен человек компетентность в области систем менеджмента значительно выше других игроков, который, например, является экспертом одной из систем менеджмента.

При желании игру можно сделать не только настольной, но и разработать соответствующее несложное программное обеспечение с целью обновления и корректировании игрового поля и карточек с учетом новых требований к системам менеджмента.

На предприятии могут адаптировать игру под имеющуюся сертифицированную интегрированной систему менеджмента, включать вопросы касающихся конкретных целей организации в области качества, процессов, методов контроля, как конкретная деятельность обучаемого персонала влияет на результативность системы. Руководитель организации может мотивировать победителей игры, например, дополнительным премированием, продвижением по службе, грамотой и т. п. В университете преподаватели могут мотивировать студентов, ставших победителями игры, повышением оценки на экзамене.

По сравнению с известными методами обеспечения и оценки компетентности и осведомленности персонала, игра более эффективна, так как кроме приобретения знаний соответствующих стандартов систем менеджмента и различного типа задач, ее предназначение – играть, а это интереснее, чем просто изучать «скучный» стандарт и решать надоевшие задачи. При этом игра служит отличной мотивацией, для того, кто хочет выиграть, появляется дух соперничества между обучаемыми, осуществляется работа в команде, демонстрируется пример для подражания в знаниях, к которому надо стремиться.

Игра поможет повысить результативность обучения, установить соответствующую компетентность и осведомленность персонала, студентов.

Литература

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METHODS FOR DESIGNING BIOLOGICALLY INSPIRED ROBOTS

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A new approach and development of special problem-solving methods and procedures at the initial design stages of optimized technical systems is presented The first subject of work is the development of new functional principles for robots and similar technical systems with the use of a tree-like classifications and a transparent morphological Cube. The second method is based on the principles of special transformation techniques, transforming images of a biological object into a technical device by means of graphical modelling in the form of computer animation. The third introduced method is based on the combination of biological and technical objects. The developed method is based on the well-known principle known as the combination of alternative systems.

All methods enable the transfer of characteristics and structure from biological object (i.e. its kinematics) to technical object leading to new desirable characteristics or optimizations of existing technical objects.

In recent years the research focus has been shifting more and more towards legless, or appeal, locomotion systems that are modelled after snakes or worms, among others. [1]

In the literature several methods of techniques finding technical solutions, sets of software products supporting the process of technical systems design and a selection of technologies to be implemented are described. Nevertheless, having well developed tools of the analysis, these methods frequently have no effective solving tools for problems.

The essential design stage, which is discovering ideas for new functional principles of technical systems, is based almost entirely on the know-how of the engineer and does seldom evolve by means of the computer.

The subject of our work is the development of new functional principles for robots with the use of the biological objects as prototypes. In our paper the description of the synthesis process of new robots and their development is presented. [2], [4]

The developed method is based on the morphological box of Zwicky The multivariate interactive matrix for OLAP technology is used for the design and development of robots and similar technical systems.

The functions of robots can be realized in several essentially different ways. Developer awareness of all existing possible variants is limited. A morphological method is used for the selection of the kinematics, the principles of action, and the prototype. An interactive computer image is applied for selecting properties of the robot and for subsequent analysis. By means of this interactive visualization, a developer receives hundreds of new variants of robots and their biological prototypes for checking their technical feasibility and calculations. For the synthesis of new robots, a user can choose useful functions. After choosing them he receives some constructive variants of the robot with various combinations of parameters.

The multivariate interactive matrix is used for the design and the development of mobile robots and similar objects. The choice of coordinate axes of a morphological Cube is the most important and comprehensive part of the work. Our program allows speeding up this procedure.

For the synthesis of a new cube, it is possible to choose the tree-like classification in special triangular tables. After choosing them he receives some new morphological boxes with various combinations of parameters.

These classifications are inserted into special triangular tables located in a three-dimensional space and each of them has only one degree of freedom. By moving these tables along each of axes of 3D Cube, an engineer-developer generates a new morphological Cube.

The Morphing method is based on continuous transformation from the biological prototype into a technical system. In the intermediate transformation stages the object being transformed contains both, the characteristics and kinematics of the technical system and of the original nature-based prototype. [3]

The developed method enables the transfer of characteristics and the structure from one object (i.e. its kinematics) to another leading to new desirable characteristics or optimizations of existing technical objects. Thus, computer animation is implemented with the use of graphical modelling and the ability to develop new functional principles of technical systems (i. e. new motion principles, new kinematics etc.) is provided.

A Morphing tool is used to realize the graphical transition from known to new forms of motion. Morphing means the process of transformation of one object into another object. Therefore, a special software for computer animations is used.

Often, engineers may directly use these intermediate results to initiate new technical solutions. In the intermediate transformation stages the object being transformed contains both, the characteristics and kinematics of the technical system and of the original nature-based prototype.

For one technical system the process can be repeated several times by changing the prototypes only, the process of transformation only, or both simultaneously. Furthermore, it is possible to reprocess the structure gained in one of the intermediate stages as new prototypes or as a new technical system for the subsequent Morphing. Objects can also be recorded by VCR, inserted into the computer program and morphed thereafter. [2]

In our opinion, there exist only 4-5 main principles of functioning of biologic objects for providing the necessary trajectory of the legs or body movement. In known robots the several actuators for moving each leg are used. Our robots principle difference allows to use each actuator for moving several legs. Thus, we managed to minimize number of actuators at the robot. [5]

Minimization of number of actuators multi-legged robots can be reached through:

– use of periodical changing the shape of the body of the robot in horizontal dimension (salamander, lizard);

– use of periodical changing the size of the body of the robot in vertical dimension (flying insects);

– use of anisotropy of friction (snake, worm);

– use of periodical character or feature of trawling wave (holothouria, worm);

– use of multidimensional resonance swinging of elastic extremities (mosquito);

– reducing of number of bearing legs (kangaroo, basilisk, birds).

For micro robots it is possible to use a principle of movement as at Polichetae. In this biologic object the legs have no actuators and no degrees of freedom relative to a body. To create necessary trajectory of a distal end of a leg, Polichetae and Holothouria uses deformation of the case as trawling wave. The number of legs-needles is not limited, but number of the actuators enabling deformation of the case, is minimal. It is possible to create tiny robot with a plenty of legs and with low number of small-sized actuators. The salamander bends its body in a horizontal plane and due to this, moves the body relative to the points of support. By using deformation of a robot body in a horizontal plane it is possible to provide it's moving due to a minimum number of actuators. The actuators are not connected to legs and they are necessary only for deformation of a robot body.

Some flying insects create resonant oscillations of the wings due to periodic change of the form and the sizes of the rigid body. These insects' muscles are connected not to the wings, but to the walls of a rigid body and deform it. Deformation of body turns into swinging of wings. It is possible to create the moving robot at which the case vibrate, and legs have no actuators. The necessary trajectory of distal part of a leg is formed due to excitation of the high-frequency swinging in proximal part of an elastic curvilinear leg and due to mechanical transformation of these swinging in low-frequency.

Applying the techniques described allows us to create several new devices, including a self-

propelling catheter for minimally invasive surgery and other devices for medical applications.

For movement of multi-legged robot through a pipe we use the trawling wave of the Holothouria for «Holothourobot». Merging the kinematics of a salamander with the kinematics of an octopod allows us to develop «Eightleggedrobot» – a new eight legged robot with only three actuators. Combining a flying insect and a piezotransducer with extremities supplies a new object – the piezomicrorobot «Minchrobot». Merging the bristle-body with the cross vibrations of unbalanced motor allows us to develop a new Vibrobristleworm.

Using our interactive software for the improvement of «man-computer» dialogue is proposed to visualize a selection process of properties and parameters of the robots on a computer screen. The analyses of biological objects and alternative technical systems allow us to create several new biologically inspired robots.

We used the tree-like classifications for automatic construction of various transparent morphological Cubes (boxes) on the screen of a computer. The analyses of biological objects and graphical modelling of technical objects by means of computer animation (Morphing – method) offers new opportunities for the engineers. Morphing may support the engineer designing technical system implementing biological model. The described technique does not supply convertible constructive drawings immediately, however, it provides new solutions with new ideas. Furthermore, it is possible to develop essential new robots.

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МОДЕРНИЗАЦИЯ НАЦИОНАЛЬНОГО ЭТАЛОНА ЕДИНИЦЫ ПЛОСКОГО УГЛА-ГРАДУСА

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В Международной системе единиц SI единицей плоского угла является радиан. Радиан выражен через метр – основную единицу SI как отношение длины дуги сегмента окружности к радиусу окружности. Для нахождения угла косвенным путем через измерение длины используются, например, такие средства измерений как синусная линейка и угловой интерферометр.

Поскольку такой подход обеспечивает связь единицы плоского угла с основными единицами SI, существует и альтернативный подход к определению углов, который основан на делении окружности. Деления окружности образуют замкнутый цикл и в сумме равны 2π радиан. Таким образом, окружность является естественным эталоном плоского угла.

В настоящее время в БелГИМ имеется Национальный эталон единицы плоского угла-градуса НЭ РБ 6-01. Создан в период (1999-2000 гг.) и утвержден в качестве национального постановлением Госстандарта от № 38 от 24.09.2001 г.

Эталон востребован. Основой эталона до модернизации являлся автоматизированный лазерный гониометр ГС-1Л (данные приборы серийно выпускались на заводе Арсенал, Украина в 80-е годы прошлого столетия).

Для обеспечения национальной безопасности, интеллектуальной независимости, выпуска качественной и конкурентоспособной продукции, бесперебойного оказания метрологических услуг потребителям, не дожидаясь полного отказа имеющегося эталона. Поэтому в период с 2016 по 2018 г. создан новый Национальный эталон единицы плоского угла-градуса.

Эталоны единицы плоского угла-градуса имеются во многих национальных метрологических институтах, что подтверждается официальными данными, опубликованными на Web-сайте Международного бюро мер и весов (BIPM) в Приложении С.

Наилучшими измерительными возможностями в области измерений плоских углов обладают такие страны как Германия (PTB), Россия (VNIIM) и Великобритания (NPL). В основе со-