Изобретения (патенти и полезни модели)

1. Светослав С. Забунов, Петър С. Гецов, Гаро Х. Мардиросян. СИСТЕМА ЗА УПРАВЛЕНИЕ НА ТРИФАЗЕН БЕЗКОЛЕКТОРЕН ЕЛЕКТРОДВИГАТЕЛ. *Патентно ведомство на Република България*, 111705/20.02.2014, 1952/29.08.2014.

Реферат

Система за управление на трифазен безколекторен електродвигател, състоящ се от батериен блок (1), отделните галванични елементи 1I, 1II . . . 1n на когото са свързани към съответните входове на комутиращ блок (2), трите изхода на който са включени към трите входа на блока за управление на електродвигателя (4), като комутиращият блок (2) е в двупосочна връзка с блок за управление на комутацията (3), който от своя страна е двупосочно свързан с команден блок (5), като последния е и в двупосочна връзка с блока за управление на електродвигателя (4), а трите вход-изхода на последния са свързани двупосочно със съответните три фазови намотки на електродвигателя (6).

Приложението е в безпилотни летателни средства задвижвани от електрически двигател, битови електроуреди, роботи, електрически автомобили, електрически ролери, плавателни съдове и др., при които за източник на електрическа енергия се използва многоелементна електрическа батерия.

2. Светослав Светославов Забунов, Петър Стефанов Гецов, Гаро Хугасов Мардиросян, Георги Ставрев Сотиров. АНТЕННА СИСТЕМА ЗА БЕЗПИЛОТЕН ЛЕТАТЕЛЕН АПАРАТ. *Патентно ведомство на Република България*, 111720/12.03.2014, 1967/30.09.2014.

Реферат

Изобретението се отнася до антенна система за осъществяване на двустранна радиовръзка между безпилотен летателен апарат (БЛА) и наземна станция. Приложението е при управление и получаване на информация от безпилотен летателен апарат (по-лек или по-тежък от въздуха), при което се използва кръгова поляризация на електромагнитното поле на антената му и се управлява динамично диаграмата на насоченост на антената в зависимост от моментната ориентация на БЛА.

Антенната система на борда на БЛА се състои от съставните три елемента 1x, 1y и 1z на летателната антена, свързани съответно с трите входа на комутаторен блок 2, трите изхода на който са свързани съответно с трите входа на предусилвател 3, чиито изходи са свързани към съответните три входа на блок за дефазиране и съгласуване на приемния тракт 4′, изходът на който е включен към входа на приемник 5, като към четвъртия вход на блок 4′ е включен изходът на автопилот 7. Към втората тройка входове на комутаторния блок 2 са включени съответно трите изхода на блок за дефазиране и съгласуване на предавателния тракт 4″, към входа на който е включен изходът на предавател 6, като вторият изход на автопилота 7 е свързан с втория вход на блока 4″. Към седмия вход на комутаторния блок 2 е включен изходът на команден блок 8, който е в двупосочна връзка с приемника 5 и с предавателя 6.

3. Светослав Светославов Забунов, Петър Стефанов Гецов, Гаро Хугасов Мардиросян. САМОЛЕТ С ВЕРТИКАЛНО ИЗЛИТАНЕ И КАЦАНЕ. *Патентно ведомство на Република България*, 2126/30.10.2015.

Реферат

Изобретението се отнася предимно до безпилотни самолети. Разглежда се витлов самолет с фиксирано крило с вертикално излитане и кацане (ВСВИК). Приложението е при дистанционни изследвания на наземни обекти, издирване на хора, дейности, свързани с екологията, борба с бедствия и аварии, разузнавателна дейност и т.н. По принцип изобретението може да бъде използвано и при пилотирани самолети.

Летателният апарат ВСВИК има два режима на полет: хеликоптерен и самолетен, като излитането и кацането се извършват в първия режим и апаратът каца на опашката си и конзолите, държащи мотогондолите. Реализира се преминаване от единия в друг летателен режим чрез преориентиране на планера в пространството. Посоката на полет при самолетен режим се определя от фюзелажа, който има аеродинамична форма.

Съгласно фиг. 1 и фиг. 2 летателният апарат ВСВИК се състои от фюзелаж 1, към който са свързани съответно дясно полукрило 2I и ляво полукрило 2II. Към дясното полукрило 2I са прикачени директно мотогондоли с електродвигатели 3I и 3III, а между тях чрез конзола 5I към полукрилото 2I е монтирана мотогондола с електродвигател 3II. По аналогичен начин към лявото полукрило 2II са монтирани директно мотогондоли с електродвигатели 3IV и 3VI, а чрез конзола 5II – мотогондола с електродвигател 3V. На осите на всички електродвигатели са монтирани съответно витла 4I, 4II, 4III, 4IV, 4V и 4VI.

4. Светослав Светославов Забунов, Петър Стефанов Гецов, Гаро Хугасов Мардиросян, Георги Ставрев Сотиров. БЕЗЖИЧНА УНИВЕРСАЛНА СЕРИЙНА ШИНА, РЕАЛИЗИРАНА ЧРЕЗ ТЕЛЕМЕТРИЧЕН РАДИО КАНАЛ ЗА БЕЗПИЛОТНИ ЛЕТАТЕЛНИ АПАРАТИ.. *Патентно ведомство на Република България*, 2036/31.03.2015.

Реферат

Изобретението се отнася до безжична универсална серийна шина (УСШ), реализирана посредством безжичен радио канал чрез използване на готови телеметрични модули за безпилотни летателни апарати (БЛА). Приложението е при използване на УСШ-устройства на борда на БЛА, които чрез изобретението ще имат УСШ-безжична връзка с наземен компютър. Пример за такива устройства са уеб-камери, уеб-микрофони, УСШ-фотоапарати и др.

Недостатъци на известната техника са свързани с използваните модулации и честоти, като задачата на изобретението е да създаде безжична универсална серийна, която да елиминира недостатъците на предшестващата техника.

Безжичната универсална серийна шина, се състои от летателна станция и наземна станция, които са изградени съответно от летателна антена 1I и наземна антена 1II, свързани съответно към летателен модул за телеметрична радио връзка 2I и наземен модул за телеметрична радио връзка 2II като последните две съответно се намират в двупосочна връзка с летателен УСШ-интерфейсен модул 3I и наземен УСШ-интерфейсен модул 3II, които от своя страна са двупосочно свързани съответно с летателно УСШ устройство 4 и наземен компютър 5.

5. Светослав С. Забунов, Гаро Х. Мардиросян. МУЛТИРОТОРЕН ХЕЛИКОПТЕР. *Патентно ведомство на Република България*, 112131/02.11.2015.

Реферат

Мултироторният хеликоптер се състои от 12 ротора (1I, 1II, …, 1XII), разположени под равнината на планера (2) на хеликоптера в оптимална конфигурация, гарантираща максимално покритие без припокриване. Конфигурацията на шасито представлява двойка успоредни греди 2I (2I-1 и 2I-2) към която е монтирана друга двойка успоредни греди 2II (2II-1 и 2II-2), перпендикулярна на първата и лежаща в същата равнина.

Приложението е в безпилотни и пилотирани летателни средства, задвижвани от електрически двигатели или двигатели с вътрешно горене и използвани за фотографиране и картографиране и други дейности при дистанционните изследвания, както и с военно приложение.

Посредством аеродинамична сила, създавана от роторите се постига полет на хеликоптера и неговото движение във въздушното пространство по вертикално и хоризонтално направление. Въздушният поток, създаден от роторите не среща планера, който се намира над роторите и не създава аеродинамична сила в посока надолу, която е нежелана. От друга страна, оптималната конфигурация на роторите един спрямо друг и на планера (шасито) спрямо роторите гарантират минимална маса на летателния апарат. По този начин времето на полет, обсега на полета и масата на полезния товар се максимализират.

6. Светослав Светославов Забунов, Гаро Хугасов Мардиросян, Румен Дончев Недков. ЦИФРОВ КОМПЮТЪР, РЕАЛИЗИРАН ЧРЕЗ БИСТАБИЛНИ РЕЛЕТА. *Патентно ведомство на Република България*, 2821/15.11.2017.

Реферат

Изобретението се отнася до цифров компютър, реализиран посредством бистабилни релета. Приложението е при обучение на студенти и ученици в университетите и училищата по предметите информатика, информационни технологии, електроника и физика.

Недостатъци на известните цифрови компютри, които използват бистабилни релета са, че те не са изцяло базирани върху релета, а също така използват и транзистори и/или радио лампи, което затруднява разбирането на принципите на работа на цифровия компютър при обучението на студенти и ученици. Също така съществуващите цифрови компютри, които използват релета и не използват радио лампи, транзистори и/или интегрални схеми, са базирани върху моностабилни релета и не използват бистабилни релета, при което модулите на компютъра, не извършващи превключване продължават да консумират електроенергия. Тези компютри трудно могат да бъдат захранвани с батерии и губят съдържанието на RAM паметта си при прекъсване на електрозахранването.

Задачата на изобретението е да създаде цифров компютър, реализиран посредством бистабилни релета без да се използват моностабилни релета, радио лампи, транзистори и/или интегрални схеми и така да се избегнат недостатъците на съществуващата техника.

Задачата е решена чрез създаване на цифров компютър използващ бистабилни релета и неизползващ моностабилни релета, радио лампи, транзистори и/или интегрални схеми. Цифровият компютър се състои от процесор 1, тактов генератор 2, RAM памет 3, ROM памет 4, контролен пулт 5 и дисплей 6.

7. Гаро Хугасов Мардиросян, Петър Стефанов Гецов, Светослав Светославов Забунов. ТАНДЕМ ВЕРТОЛЕТ. *Патентно ведомство на Република България*, 112529/15.06.2017.

Реферат

Тандем вертолетът се състои от два хоризонтални ротора 1I и 1II, разположени под равнината на планера (шасито) 2. Конфигурацията на шасито представлява хоризонтална греда 2I, в двата края на която са монтирани две вертикални конзоли 2II и 2III. На върховете на двете конзола са разположени по две двойки вертикални ротора 3I , 3II , 3III и 3IV.

Приложението е в безпилотни и пилотирани летателни средства, задвижвани от електрически двигатели или двигатели с вътрешно горене и използвани за дистанционни изследвания и други дейности в областта на отбраната и борбата с организираната престъпност и тероризма.

Посредством аеродинамична сила, създадена от роторите се постига полет на тандем вертолета и неговото движение във въздушното пространство по вертикално направление. Чрез вертикалните ротори се реализира промяна на наклона на планера и респективно хоризонтално придвижване. Въздушният поток, създаден от хоризонталните ротори не среща планера, който се намира над тях и не създава аеродинамична сила в посока надолу, която е нежелана. От друга страна, оптималната конфигурация на роторите спрямо планера гарантира минимална маса на летателния апарат. По този начин времето на полет, обсега на полета и масата на полезния товар се максимализират.

8. Светослав С. Забунов, Гаро Х. Мардиросян, Петър С. Гецов. АКУСТИЧНА АНТИ-ДРОН РАЗУЗНАВАТЕЛНА СИСТЕМА, БАЗИРАНА НА ПРИВЪРЗАН АЕРОСТАТ. *Патентно ведомство на Република България*, 112526/14.06.2017.

Реферат

Акустична анти-дрон разузнавателна система, базирана на привързан аеростат се състои се от аеростат (1), шаси (2), сензорни кутии (3I), (3II) ... (3n), в които са монтирани акустични сензори, корда (4), наземна станция (5), електрически кабел (6) и радио-блок (7).

Под привързаният аеростат (1) е монтирано кръгло шаси (2), по периферията на което са разположени сензорни кутии (3I), (3II) ... (3n) с акустични сензори. В сензорните кутии могат да бъдат разположени и видео камери за наблюдение, лидари, радиолокатори (радари), радио приемници и радио приемо-предаватели с цел откриване, следене, опознаване и класификация на дронове.

Аеростатът (1) е привързан към наземна станция (5) с помощта на корда (4), която може да бъде съпроводена и с проводник (6), по който апаратурата, монтирана към шасито (2) се захранва и също така се осъществява комуникация между нея и наземната станция (5).

9. Светослав С. Забунов, Гаро Х. Мардиросян, Петър С. Гецов, Ванг Бо. РОБОТИЗИРАНА ЛОДКА ЗА АКУСТИЧЕН И ВИДЕО КОНТРОЛ. *Патентно ведомство на Република България*, 112539/07.07.2017.

Реферат

Изобретението се отнася до роботизирана лодка за акустичен и видео контрол, предназначена за непрекъснато във времето откриване, локализиране, следене и класифициране на преминаващи летателни и плавателни апарати. Приложението е при охрана на водни граници, водоеми и други обекти с прилежащи водни басейни, както и при подпомагане на спасителни операции

На плавателният съд (лодка) (1) са монтирани сонарни модули (2I…2IV), акустични приемници (3I…3IV), слънчеви батерии (4I…4IV), платформа (5) за кацане и зареждане на нано-дронове (6II…6n) и командно-комуникационния блок (7), като сонарните модули (2I…2IV) и акустичните приемници (3I…3IV) са свързани двупосочно с командно-комуникационния блок (7) чрез кабелна връзка, а последният е в двустранна радио връзка с летящия в момента нано-дрон (6I), който е от своя страна е в двустранна радио-връзка с базова станция (8) която същf е в двустранна радиовръзка с командно-комуникационния блок (7).

Публикации в научни списания

1. Ivanov, K., S. Zabunov. A comparison between Sharable Content Object Reference Model and Individually Adaptive Learning Management System Model. *INFORAMTION TECHNOLOGIES AND CONTROL journal*, ISSN 1312-2622, YEAR VI, №1/2008, pp. 34-39

Abstract

Sharable Content Object Reference Model (SCORM) is compared to the developed by the authors Individually Adaptive Learning Management System Model (IALMSM). The comparison investigates the particular realization of the main points of a generalized learning management system model and also the specific approaches the two models exhibit. SCORM is flexible, diverse, highly generalized, complex and rich in definitions and parameters. It allows the presentation and implementation of a broad variety of educational content structures and strategies. IALMSM offers still highly generalized model for sequencing but has compact approach to the sequencing realization, although based on the same block structure paradigm. IALMSM offers the session attempt approach in contrast to learning activity attempt approach implemented in SCORM. The use of a system specific formal language aims at investigating the concept of a direct and specific formalization of the learning content and adaptive behavior strategies seeking a higher level of language simplicity and specificity.

2. Забунов, С. Реализация на интерпретатор на авторски специализиран език в Индивидуално-адаптивна система за електронно обучение. *Списание АВТОМАТИКА И ИНФОРМАТИКА*, ISSN 0861-7562, Год. XLII, 3/2008, pp. 62-65

Резюме

Настоящата статия прави преглед на интерпретатор на авторски специализиран формален език за описание на генериращата структура на учебния материал в Индивидуално-адаптивна система за електронно обучение (ИАСЕО).

3. Zabunov, S. “Stereo 3-D Vision in Teaching Physics”, *Phys. Teach.*, Vol. 50, Issue 3, pp. 163, Mar. 2012.

Abstract

Stereo 3D vision is a technology used to present images on a flat surface (screen, paper, etc.) and at the same time to create the notion of three dimensional spatial perception of the viewed scene. Observing scenes and settings of studied physical phenomena in stereo 3D vision is a helpful tool when teaching physics. Stereoscopic 3D photographs, figures, plots and interactive simulations substitute to certain extent the laboratory setting, where the latter may be inapplicable, expensive or dangerous to build and present to students. On the other hand, showing 3D visual materials to students enhances their involvement in the educational process as young people are very attracted nowadays to modern 3D motion pictures and hi-tech visual effects. A great number of physical processes are much better understood when viewed in 3-dimensional graphical interface in stereo 3D vision compared to standard flat 2D presentation. The current paper describes the modern stereo 3D technologies that are applicable to various tasks in teaching physics in schools, colleges and universities. Examples of stereo 3D simulations developed by the author can be observed on the Internet.

4. Zabunov, S. Online Stereo 3D Simulation in Studying the Spherical Pendulum in Conservative Force Field. *European J of Physics Education*, Vol 4, No 4, 2013

Abstract

The current paper aims at presenting a modern e-learning method and tool that is utilized in teaching physics in the universities. An online stereo 3D simulation is used for e-learning mechanics and specifically the teaching of spherical pendulum as part of the General Physics course for students in the universities. This approach was realized on bases of interactive simulations on a personal computer, a part of the free online e-learning system at http://ialms.net/sim/. This system was practically applied with students at Sofia University, Bulgaria, among others. The shown simulation demonstrates the capabilities of the Web for online representations and visualizations of simulated physics processes that are hard to observe in laboratory conditions with all the accompanying parameters, vectors, quantities and trajectories. The discussed simulation allows the study of spherical pendulum both in conservative and non-conservative force fields. The conservative force field is created by the earth gravity force, whose magnitude may be varied in the simulation from positive to negative values, while its direction is always vertical. The simulation also supports various non-conservative forces that may be applied to the pendulum. The current article concentrates on the case of conservative forces acting.

5. Zabunov, S. Effect of Poinsot Construction in Online Stereo 3D Rigid Body Simulation on the Performance of Students in Mathematics and Physics. *Eurasian J. Phys. & Chem. Educ.*, Vol 5, No 2, 2013

Abstract

The current paper aims at presenting the effects of free online stereoscopic 3D simulation developed by the author on the performance of students in mathematics and physics. The simulation visualizes the Poinsot construction in free rigid body motion. The student is assisted in understanding the famous construction and in better comprehending the Newtonian mechanics and mastering its underlying mathematical model. The Poinsot construction is rendered in stereo 3D graphics in the web browser and the simulation shows the construction's inherent elements, such as invariant ellipsoids, invariant plane, polhode, herpolhode, etc. The latter are watched along with a large number of involved parameters:

vectors and scalars. The presented material is directed towards university students taking the Analytical (Mathematical) Mechanics courses in the Faculty of Mathematics and Informatics and students taking the Theoretical Physics and General Physics courses in the Faculty of Physics in Sofia University, Bulgaria, but is not limited to use in other universities due to simulation's free unrestricted access on the Internet. The software was tested and its effectiveness was ascertained through experimental and control groups. Data collected in such experiments is presented in order to support the relevance of the study. Stereoscopic 3D simulations are a fruitful method for observation of phenomena hard to realize in laboratory conditions such as weightlessness. The simulation, discussed in this paper can be viewed and used from http://ialms.net/sim/ web address.

6. Zabunov, S, M. Gaydarova. Binet Construction in Online Stereo 3D Visualization. *Chemistry*, 22, 770-777 (2013).

Abstract

The present paper describes an interactive online stereoscopic 3D visualization aimed at e-learning rigid body mechanics. The visualization is realized using a numerical simulation. This learning tool demonstrates free rigid body motion while visualizing the Binet construction. The visualization and the underlying simulation was developed with the idea to help students in their understanding of Newtonian mechanics, mastering its underlying mathematical apparatus and creating a method for observation of phenomena hard to realize in laboratory conditions, such as absence of gravity. The Binet construction is interactively presented in 3D graphics with all of its inherent elements, such as invariant ellipsoid, invariant sphere, angular momentum vector trajectory, etc. The simulation also demonstrates a large number of vector and scalar parameters. This material is directed to university students taking the Analytical (Mathematical) Mechanics courses and Theoretical Physics and General Physics courses. It may be used at any university – the simulation is published with free access on the Internet without restrictions of any kind (http://ialms.net/sim/).

7. Zabunov, S., M. Gaydarova. Rotating the flying disc in a stereo 3D simulation, *Lat. Am. J. Phys. Educ.*, 7, 517-520 (2013), pp. 192-195.

Abstract

Rigid body motion is part of mechanics that students find hard to understand. It is due to the inability to exhaustively demonstrate such a motion in laboratories. For example, throwing a disc happens fast and the motion cannot be properly observed. Also it is not possible to show vectors describing the rotational motion while the body is moving. These limitations considerably hamper the comprehension of the studied phenomena by students. The current article tries to demonstrate the use of free online stereoscopic 3D simulations as a virtual laboratory. The well known recreation game of throwing a flying disc hides important physical insights. The motion of the flying disc is simulated and the rotation process is analyzed qualitatively. The learning process using the simulation is followed and the student's benefits of utilizing the simulation are disclosed. The used stereo 3D simulation of rigid body rotation can be observed free online at http://ialms.net/sim.

8. Getsov, P., D. Yordanov and S. Zabunov. Unmanned Airplane Autopilot Tuning. *International Journal of Engineering Research and Applications*, Vol. 4, Issue 7 (V.5), July 2014, pp. 01-07.

Abstract

This article considers different approaches for autopilot controller gain values adjustment. The correct autopilot performance is tested using modeling methods. A variant of land-based autopilot is considered. Examined are scenarios of UAV airplanes in level flight. The latter are applicable to tasks such as remote sensing, controlled area surveillance, etc.

9. Getsov, P., D. Yordanov and S. Zabunov. Unmanned Aerial Vehicle Flight Control over a Circular Path by Means of Manual Takeoff and Automatic Landing. *Research Inventy: International Journal of Engineering And Science*, Vol.4, Issue 7 (July 2014), pp. 49-53.

Abstract

The present paper advices a platform used for research of standard unmanned aircraft flight scenarios. Autopilot control method was used to model an unmanned aircraft flight in the line of sight. Ideas of manual takeoff and automatic landing were tested. Authors present to researchers the aircraft control test results. In the essence of the presented approach is the creation of highly simplified control from the pilot point of view. Such a method allows the operator to control the airplane through abrupt inputs to the control panel without leading to a crash.

10. Getsov, P., D. Yordanov and S. Zabunov. Unmanned Aerial Vehicle Failure Modes Algorithm Modeling. *IOSR Journal of Engineering (IOSRJEN)*, Vol. 04, Issue 07 (July. 2014), V.2, pp. 55-59.

Abstract

The current article studies various predictable failure trajectories, observed during control signals loss scenarios. Using modeling techniques, certain failure mode algorithms are verified. The examined instances of failures are tested in the line-of-sight area. Certain autopilot failure regimes are studied and the resulting trajectories of airplane uncontrolled flight are scrutinized for determining failure resistant plane characteristics.

11. Zabunov, S., Getsov, P., Mardirossian, G. Development of the Experimental Multirotor Unmanned Aerial Vehicle Helicopter Models of the XZ-Series. *Aerospace Research in Bulgaria*, №26/2014, SRTI-BAS, Sofia, pp. 207-219.

Abstract

In a large number of cases, depending on the aims and tasks of the remote Earth sensing experiment, the usage of airplane and helicopter flying laboratories is economically well-founded. On the other hand, surveys of dangerous areas are often needed (wildfires, radiation accidents, explosion hazard facilities, etc). In all those cases it is expedient to use unmanned aerial vehicles (UAVs). During the last few years, the radio controlled UAVs have gained large prominence, specifically the multirotor helicopters have established themselves as the standard surveying and research flying platforms. They are predominantly used for the purpose of remote sensing studies.

In the current article, authors have presented the benefits of the unmanned multirotor helicopters, designed for remote sensing applications of specific areas of the Earth surface. The idea and realization of three new models of multirotor helicopters from the XZ-series are disclosed. The major technical and operational capabilities are analyzed and diagrams of the

avionics of the discussed models are shown. Special attention is devoted to the airframes. The implementation of the XZ-series helicopters in projects developed in Space Research and Technology Institute at the Bulgarian Academy of Sciences is discussed. Mainly, attention is drawn to the National Aerospace System for remote sensing of the Earth in the context of its usage for monitoring and protection from natural disasters.

12. Getsov P., S. Zabunov, G. Mardirossian, G. Nikolov. Using Unmanned Helicopters for Thermal Imaging. *ИССЛЕДОВАНИЕ ЗЕМЛИ ИЗ КОСМОСА*, 2015, No 5, с. 84–92. ISSN: 0205-9604, Russia, pp. 84-92.

Abstract

The constantly increasing requirements for environment protection and disaster management call for implementation of modern technical facilities and technologies for monitoring that would allow gathering of the needed information in real time. An innovative approach in this regard is the implementation of unmanned aerial vehicles (UAV) for discovery, observation and assessment of natural disasters, technological accidents, air pollution, security and control of the energy transportation infrastructure, etc. The current article offers a novel approach for utilization of unmanned helicopters for remote sensing research and surveillance in the field of thermal imaging that offers better signal to noise ratio in the gathered images.

13. Getsov, P., S. Zabunov. Quaternions Implementation Benefits for Simulation of Unmanned Aerial Vehicles and Satellite Motion. *International Journal for Scientific Research & Development*, vol. 2, issue 6, 2014, pp. 100-102.

Abstract

The current paper describes how quaternions are used successfully and effectively in simulations of unmanned aerial vehicles (UAVs) and satellite motion through definition of the UAV airframe or satellite body as a rigid body. By such means the authors try to raise interest among students and scientists in the mathematical formalism of quaternions that was very popular more than 100 years ago, but was replaced by vectors and matrices. Nevertheless, quaternions benefits make them valuable in numerous tasks, among others the numerical integration of rigid body motion dynamics equations. Simulations, part of the current project, can be viewed on http://ialms.net/sim/ web address.

14. Zabunov, S., P. Getsov, M. Gaydarova. Stabilization of Free Rigid Body Motion Stereo 3D Simulation through Invariants, *International Journal of Advanced Research in Computer Science*, Volume 5, Number 6, July-August 2014, pp. 9-16.

Abstract

A good spatial perception of the investigated physical phenomenon is important for obtaining successful outcome of the research process. Stereoscopic 3D simulations in a full-fledged online environment are applicable in scientific research of satellite and unmanned aerial vehicle motion. Simulating complex mechanical problems for scientific and experimental tasks requires not only precision to certain degree, but also correct and consistent representation of the physical laws inherent to the simulated formalism. To attain this aim, a genuine stabilization approach is needed.

The current paper describes an environment for simulation of free rigid body motion while conserving certain invariants in order not to violate the underlying formalism of the Newtonian classical mechanics even under the inevitable errors inherent to the numerical integration. The dynamic stabilization through invariants of the free rigid body motion simulation is depicted. The simulation, subject of the current paper, may be observed on http://ialms.net/sim/ web address.

15. Zabunov, S., P. Getsov and M. Gaydarova. The Rigid Body Motion Table in a Matrix Form. *International Journal of Science and Research*, Volume 3 Issue 7 July 2014, pp. 1867-1872.

Abstract

Rigid body motion table is a celebrated piece of knowledge and educational cornerstone found in almost all theoretical mechanics textbooks. What these tables lack is the complete presentation of all quantities describing the rigid body motion, namely the orientation or the angular position of the rigid body. This omission is due to the vector formalism that is used. To correct this inconsistency the authors show how the same table should be written using matrix formalism. The authors also show how the fixed table helps students to much easier derive frequently used formulas and equations regarding theoretical mechanics and more specifically rigid body motion.

16. Getsov, P., S. Zabunov and M. Gaydarova. Stereo 3D Simulation of Rigid Body Inertia Ellipsoid for The Purpose of Unmanned Helicopter Autopilot Tuning. *International Journal of Engineering and Science Invention*, Vol. 3, Issue 8, v.1, 2014, pp. 28-35.

Abstract

The current paper aims at presenting the capabilities and benefits of an online stereo 3D simulation for the purpose of unmanned helicopter autopilot tuning. The parameters of the helicopter airframe are important for tuning the gains in the autopilot. The airframe is modelled as a rigid body whose inertial properties are fully described by the inertia ellipsoid. The inertia ellipsoid is another form of presenting the moment of inertia tensor of rigid bodies but instead of using a numerical approach the described method implements 3D graphical visualization. The current paper focuses on the benefits from stereoscopic graphical 3D presentation of the inertia ellipsoid and how such a method helps designers and researchers analyse, synthesise and tune unmanned helicopter autopilot algorithms. The simulation, subject to the current material, may be observed at the following web address: http://ialms.net/sim/.

17. Getsov, P., S. Zabunov, G. Mardirossian. H-Airframe Benefits for Constructing Quad-Rotor Unmanned Helicopters. *International Journal of Science and Research*, Volume 3 Issue 8 August 2014, pp. 21-23.

Abstract

The H-airframe also called “fuselage”-airframe is a quad-rotor airframe structure that exhibits a number of benefits over the classical four-rotor helicopter airframes, but it is still underestimated and not widespread among designers. The current paper aims at disclosing these benefits and comparing the H-airframe against most well-known airframes used in the modern quad-rotor unmanned helicopters. Special attention is drawn to the dynamical

characteristics of the H-airframe and how unmanned helicopters based on this airframe structure excel the standard quad-rotor airframes in mechanical rigidity, efficiency and maneuverability.

18. Getsov, P., S. Zabunov, G. Mardirossian. Constructing Quint-rotor Unmanned Helicopters using an H-airframe. *International Journal of Engineering, Science and Mathematics*, Volume 2, Issue 10, Oct. 2014

Abstract

In the recent years the interest in unmanned helicopters is growing due to the advent of efficient electric motors and batteries. The most abundant helicopters are the multi-rotor aircrafts with four rotors due to their simplicity and lower cost. Nevertheless, researchers, commercial users, organizations, institutions, companies and enthusiasts are planning on implementing unmanned helicopters with more than four rotors. A major element in the design process of these machines is its airframe. A thoroughly designed airframe may significantly increase performance and reliability of the aircraft.

The current paper focuses on airframes of quint-rotor aircraft and specifically reveals the benefits of a new quint-rotor airframe, called H-quint-airframe. The article discloses the benefits of the H-airframe for quint-rotors when compared to the classic quint-rotor helicopter airframes that are used by most parties at present day.

19. Getsov, P., S. Zabunov, G. Mardirossian. Unmanned Hex-Rotor Helicopter Based on an H-Airframe. *International Journal for Scientific Research and Developement*, vol. 2, issue 7, 2014, pp. 1-2.

Abstract

Unmanned multi-rotor helicopters are gaining prominence in the past several years among researchers and industry. A notable example of multi-rotor implementation is the cinema industry. The lower cost of using unmanned aerial vehicles (UAVs) for movie making compared to piloted aircraft has promoted multi-rotor helicopters as photographic platforms for professional tasks of filming motion picture and still photographs. Such flying platforms require significantly higher lifting power compared to amateur and hobby UAVs. Further requirements include low vibrations and stability of the helicopter. On account of these characteristics, the most widespread platform for photography is the six-rotor helicopter with “star”-airframe. Simple, yet very productive, it has satisfied to considerable extent the demand by the filming industry and other branches of users. But it still has drawbacks that should be addressed by proposing a newer and innovative airframe design. The current paper presents a new hex-rotor helicopter airframe design based on the H-configuration and compares it with the most widespread “star”-configuration. All benefits in various aspects of efficiency and effectiveness are disclosed.

20. Getsov, P., S. Zabunov, G. Mardirossian. Using the H-Airframe Paradigm for Constructing Septa-Rotor Unmanned Helicopters. *International Journal of Engineering, Science and Mathematics*, Vol 3 Issue 4, Dec. 2014, pp. 76-85.

Abstract

Using multi-rotor unmanned helicopters for various purposes becomes a practice in the recent years, due to the increased efficiency of electrical motors and batteries and at the

same time their lowering cost. Multi-rotors are applicable in a number of situations, from pollution monitoring and disaster management to scientific research.

Starting from tri-copters and quad-copters users are more and more demanding multi-rotors with larger number of propellers aiming at lower risk, higher efficiency, larger payloads, etc. Among those helicopters are machines with five, six, seven, eight or even a larger number of propellers.

The current paper presents a comparison between the standard sever-rotor unmanned helicopter in “star”-configuration and a new design again with sever rotors, but using the H-airframe paradigm. The proposed design has a number of benefits that are disclosed in this publication.

21. Zabunov, S., P. Getsov, G. Mardirossian. H-Airframe Based Octo-Rotor Unmanned Helicopter. *International Journals of Engineering & Scientific Research (IJESR)*, ISSN: 2347-6532, Vol 2 Issue 11, 2014, pp. 9-18.

Abstract

The multi-rotor unmanned helicopters are getting ubiquitous during the past several years due to the advent of new magnetic technologies providing the electric motor industry with high efficiency brushless direct current motors. The applications are endless, but most common use is for camera platforms, research test bed, surveillance, disaster management, military operations, search and rescue operations, etc.

Helicopters with larger number of rotors are generally desired due to their inherent performance benefits and reliability advantage over helicopters with lesser number of rotors.

The current article focuses on eight-rotor helicopters also called octo-rotor machines or octo-copters. Authors compare the contemporary designs while presenting a novel masterpiece of an octo-rotor helicopter based on the H-airframe paradigm.

22. Getsov, P., S. Zabunov, G. Mardirossian. Quad-Rotor Unmanned Helicopter Designs. *Asian Journal of Natural & Applied Sciences*, vol. 3, n. 3, Sep. 2014, Japan, pp. 77-82.

Abstract

The quad-rotor unmanned helicopter design has superior capabilities in comparison to any other configuration because four rotors is the minimum number that assures attitude management without the need for control surfaces or tilt rotor mechanisms. Quad-rotors have drawbacks too, but the simplicity of their design and the low costs for obtaining and maintenance of such a helicopter make them most ubiquitous among multi-rotor aircraft.

Starting from the four rotor paradigm authors have developed innovative designs of quad-rotor unmanned helicopters that have further benefits from the current designs and although unable to offer the safety of helicopters with larger number of propellers they present novel features and give researches and users new flying platform for their projects and activities.

23. Zabunov, S., P. Getsov, G. Mardirossian. High-Speed Unmanned Octo-Rotor Helicopters. *Asian Journal of Natural & Applied Sciences*, vol. 3, n. 3, Sep. 2014, Japan, pp. 1-7.

Abstract

The importance of unmanned aircraft is increasing in the last few years. Although unmanned aerial vehicles were used long ago even before WWII, the advance in electric motor technologies and battery chemistries has made possible for a broad range of users to utilize in their projects and activities the unmanned multi-rotor helicopters.

Multi-rotor helicopters help in a number of situations, from scientific research to man rescue operations. Their most significant drawback is that they hardly withstand wind and travel at low speeds thus having very limited range.

The current paper presents novel development of high-speed unmanned multi-rotor helicopters that solve to great extend these problems by utilizing vertical propulsion propellers in order to achieve high-speed of flight. Two models of the experimental XZ-series are described.

24. Zabunov, S., P. Getsov, G. Mardirossian. XZ-4 VERTICAL TAKEOFF AND LANDING MULTI-ROTOR AIRCRAFT. *Asian Journal of Natural & Applied Sciences*, vol. 3, n. 4, Dec. 2014, Japan, pp. 1-7.

Abstract

The rapid development of unmanned multi-rotor helicopters has made small electric helicopters ubiquitous and wide spread in our everyday life. From photographic platforms to scientific test beds these machines have invaded our work and activities to a significant extend engaging into areas of service and utilisation that no other technical tool after the personal computer and the smart phone has ever achieved. But with its fast development the limits of the new technology soon are revealed. Multi-rotor helicopters cannot fly to a long distance nor can they sustain prolonged periods of flying without charging the batteries. On the other hand, the good old fixed wing aircraft now equipped with electric motors copes well with such tasks.

A solution to this requirement is the already well studied and tested vertical takeoff and landing technology. But all present developments implement cumbersome and extremely complex systems to achieve the so defined goal.

The current article presents a novel construction of the vertical takeoff and landing electric multi-rotor aircraft, which solves all present problems of complex and expensive structures and systems and offers a simple yet high quality vertical takeoff and landing aircraft design.

25. Getsov, P., S. Zabunov, G. Mardirossian. High Efficiency Voltage Doubler for Unmanned Multi-Rotor Helicopter Power Supply. *International Journal of Management, IT and Engineering*, Vol 4, Issue 11, p. 124-133, Nov. 2014.

Abstract

During the last few years unmanned multi-rotor helicopters are getting ubiquitous due to their low cost and efficiency. The power supply of these machines is lacking behind as are doing many other modules in the avionics as well and users are suffering from being unable to utilize fully the capabilities of these modern aircraft.

In order to increase flight times, high efficiency power supplies are needed. Current models of lower class use passive power supplies with efficiencies in the range of 50%. More common among expensive models are inductive power supplies. The latter ones offer efficiencies from 70% to 95%. The upper limit is hardly achievable and also these power supplies suffer from a number of drawbacks such as electromagnetic interference, high frequency operation, weight, form factor, etc.

The present article demonstrates a capacitive voltage doubler especially designed for unmanned multi-rotor helicopters with efficiency of over 98% and very small dimensions and weight. The lack of inductors and low working frequency guarantee almost none electromagnetic interference to other modules of the avionics.

26. Zabunov, S. QUATERNION-BASED AUTOPILOT FOR DODECACOPTERS - PART I. *Aerospace Research in Bulgaria*, №28/2016, SRTI-BAS, Sofia, pp. 93-112.

Abstract

The innovations in modern unmanned aerial vehicles do pose higher requirements against the autopilot aircraft control. Special demand is placed by the multirotor innovative helicopters for their unique control system and rotor positions.

The current article establishes the core of a quaternion based autopilot suitable for the innovative and award winning twelve rotor UAV helicopter Bulgarian Knight. Quaternions offer a number of benefits to autopilot systems, but their implementation to specialized autopilots used in innovative and unique drone models require exclusive attention and discussion. As a result, an efficient and flexible autopilot is attained, because quaternion computations are much faster and accurate than the other competing approaches. Nevertheless, a quaternion-based autopilot requires sophisticated software libraries with inherent significant complexity. The elevated accuracy and pliability of the quaternion method is a fertile means for developing a prototype, scientific and research autopilot that is suitable for customization in response to the novel UAVs specific needs.

Изнесени доклади на научни конференции, публикувани в пълен текст

1. Zabunov, S. & Ivanov, K., 2003. Methods and Forms of Teaching "Information systems" and "Computer networks and communications" with the Use of the Internet. *Annual of University of Mining and Geology "St. Ivan Rilski"*, Sofia, Bulgaria, 2003, Part IV: Humanitarian and Economic Sciences, Vol. 46, p. 141-144

Abstract

This article intends to study the problem of educational content of the subjects “Information Systems” and “Computer Networks and Communications” and particularly the capabilities for efficient teaching of these subjects with the use of the Internet. The report draws the benefits and drawbacks of e-learning, and drafts the components used for organizing computer based systems, needed for modernizing the education of engineers at the University of Mining and Geology “St. Ivan Rilski”. Starting from the experience of large companies as Cisco Systems and Microsoft, the changes that should take place in education of engineer specialists are drawn, with a view to the expedient accomplishment of the reform of higher education in the frameworks of the University of Mining and Geology “St. Ivan Rilski” and especially the matter of the mentioned earlier subjects. The contemporary complicated requirements to the people being educated are defined on the bases of a critical assessment of the dynamically changing technological data access and gathering by the means of the Internet infrastructure. Except that, the changed “working environment” of the educator is illustrated, which finally leads to a change in form and content of educational units and means of assessment of the future

engineer’s professional level.

2. Ivanov, K. & Zabunov S. 2003. Model of Individually Adaptive Learning Management System. *Annual Conference of University of Ruse*, 2003

Abstract

Model of Individually Adaptive Learning Management System : This article defines a Model of Individually Adaptive Learning Management System (IALMS). IALMS aims at providing students with a way of assimilating the educational material to a greater extent. Simultaneously, IALMS attempts to engage students with a study of additional topics depending on their interests and abilities.

3. Ivanov, K. & Zabunov, S., 2004. Individually Adaptive Learning Management System Project. *International Conference on Computer Systems and Technologies - CompSysTech'2004*, Rousse, Bulgaria, 17-18 June, 2004

Abstract

This article presents a project of a generalized and intelligent learning management system. The whole project is organized upon the circular information flow between the system and the learner. The main feature of the system is its adaptability to the individual learner with the goal to maximize learning process results. This aim defines three major units of the system: Tracking subsystem, Individualizing subsystem, and Adaptation subsystem. They are situated sequentially along the information stream. The result of the work is the definition of a complete Individually adaptive learning management system (IALMS).

4. Zabunov, S., 2004. A Language for Describing the Generating Structure of the Educational Material in the Individually Adaptive Learning Management System. *International Conference on Computer Systems and Technologies - CompSysTech'2004*, Rousse, Bulgaria, 17-18 June, 2004

Abstract

This paper summarizes the structure of a complete Individually adaptive learning management system (IALMS) and defines a formal language for describing the generating structure of the educational material in IALMS. It tends to establish the structural model and functionality characteristics of the Adaptive subsystem of the IALMS model. The generating structure language is explained and fully syntactically defined.

5. Zabunov, S. & Ivanov, K., 2004. Framework and Functionality of the Tracking Subsystem in the Individually Adaptive Learning Management System (IALMS). *ANNUAL OF UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI"* - Sofia, Bulgaria, Part IV: MECHANIZATION, ELECTRIFICATION AND AUTOMATION IN MINES, Vol. 47, p.137-140, 19th - 21st October, 2004

Abstract

This work presents the framework and functionality of the Tracking subsystem in the Individually Adaptive Learning Management System (IALMS). As a result of the current learning management systems analysis, there is revealed a reality of resources offered to the e-learner by the computing machines that have never been mastered. These resources belong to the intelligent computer systems. While the modern e-learning systems utilize the multimedia and communications capabilities of computers, they don't pay adequate attention

to the opportunity of a strategically planned conducting of the educational process. The small number of intelligent learning management systems differentiate from IALMS by that the latter represents a project of a generalized learning management system, not having strictly predefined pedagogical categories and structures. IALMS is built on three major units, situated subsequently along the information stream. They are: Tracking subsystem, Individualizing subsystem, and Adaptation subsystem. These units are typical for their programmability and flexibility. The current article examines the framework and functionality of the Tracking subsystem in IALMS.

6. Ivanov, K. & Zabunov, S., 2005. INDIVIDUALLY ADAPTIVE LEARNING MANAGEMENT SYSTEM (IALMS) IN THE FIELD OF THE MODERN ADAPTIVE AND INTELLIGENT E-LEARNING SOLUTIONS. *ANNUAL OF UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI"* - Sofia, Bulgaria, Part IV: HUMANITARIAN AND ECONOMIC SCIENCES, Vol. 48, p.79-84, 20th - 21st October, 2005

Abstract

This article presents an Individually Adaptive Learning Management System (IALMS), which is based on a model of adaptive and individualizing electronic education. Analyses of some of the modern approaches, models and systems for adaptive and intelligent e-learning is exhibited. These solutions are compared to the IALMS model. The main IALMS's distinguishing feature is outlined, namely the generalized model of individually adaptive learning, upon which the system has been created. The paper examines the IALMS's structure and model by analyzing the main functionality of the separate units that build the system.

7. Zabunov, S., 2005. DESCRIPTION OF THE INDIVIDUALIZING SUBSYSTEM OF THE INDIVIDUALLY ADAPTIVE LEARNING MANAGEMENT SYSTEM (IALMS). *ANNUAL OF UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI"* - Sofia, Bulgaria, Part IV: HUMANITARIAN AND ECONOMIC SCIENCES, Vol. 48, p.85-88, 20th - 21st October, 2005

Abstract

This paper presents the core and the functionality of the Individualizing subsystem in the Individually Adaptive Learning Management System (IALMS). An examination of the modern e-learning management systems is presented, which reveals the opportunity of adoption of qualitative characteristics offered by computers in the area of e-learning systems adaptation against the learner's behavior. The work analyses the summation of information about the learner and the creation of a profile of the latter, which helps to the following adaptation of the system's behavior. This adaptation is expressed in altering of the outgoing information stream (called in IALMS "educational material"). Thus strategically planned leading of the educational process is achieved as an additional, qualitatively new, characteristic of the e-learning management system. The few intelligent systems and models for e-learning differentiate from IALMS in that the latter present a project of a generalized e-learning system without strictly predefined pedagogical categories and structures. The foundation of IALMS over three major subsystems placed consecutively in the informational stream. These are: Tracking subsystem, Individualizing subsystem and Adaptive subsystem. These units characterize with programmability and flexibility. The current article examines the structure the functionality of the Individualizing subsystem of IALMS.

8. Zabunov, S. INTERNET OF THINGS AND DRONES, *SES 2015 - Scientific Conference with International Participation "SPACE, ECOLOGY, SAFETY"*, 12 – 14 October 2015, Sofia, Bulgaria, pp. 131-134

Abstract

"Internet of Things" (IoT) is a modern term gathering all or almost all devices that connect to the Internet. But why not connect drones to the Internet and control them using the Internet?

Drones are another modern trend in the high-end technological revolution and all innovations in the unmanned aerial vehicle avenue are most welcome by industry and the general user.

There are a few benefits from implementing Internet of Things in the drones and a few drawbacks. The current paper tries to disclose all aspects of using drones as Internet of Things. The author also proposes a new approach that is a partial Internet of Things realization thus avoiding the disadvantages of IoT that may be dangerous and simultaneously harvesting some of the advantages an IoT application may bear.

Публикации в научни-популярни списания

1. Забунов, С. "Зеленият" източник на светлина. *Списание Природа, БАН*, Издание №4, 2013г.

Резюме

Ефективните светлинни източници са в основата на светлинната енергийна ефективност – предпоставка за намаляване на общата консумация на електроенергия на планетата Земя. Като високо икономични устройства, полупроводниковите светодиоди се явяват „зелени" светлинни източници, които пестят енергийните ресурси. Производството на електроенергия води до замърсяване на природата – електрическите централи отделят замърсители, например въглероден диоксид, ядрени отпадъци, серни съединения. Колкото повече електроенергия се произвежда в електроцентралите, толкова повече се замърсява природата. Ефектът от използването на светодиодите е намаляване на консумирания ток и така намаляване на отделяните замърсители в природата от електроцентралите.

2. Забунов, С. Електрическите превозни средства – една забравена история. *Списание Природа, БАН*, Издание №1, 2014г.

Резюме

Безспорно една от най-модерните технологии са електрическите превозни средства. Тяхното разпространение обещава да намали вредните емисии от фосилни горива и затова те често са наричани „зелени" превозни средства. В последните години стана ясно, че електромобилът ще преобрази транспорта в световен мащаб. Най-големите автомобилни компании се стремят да предложат модели на електрически коли, с които да се включат в „бизнеса на деня". Но дали тази технология е нова или тя стои „заключена" в дълбоките архиви на технологичната история повече от 100 години?

Технологичните открития са като произведения на изящното изкуство, но понякога те остават скрити. Длъжни сме да знаем и да видим отвъд плиткия хоризонт на

днешния ден, защото в миналото съществуват прекрасни пътища на знанието, засенчени от посредствеността и изоставени в несправедлива забрава.

3. Забунов, С. Компютрите и Втората световна война. *Списание Природа, БАН*, Издание №2, 2014г.

Резюме

Втората световна война е преломен момент в човешката история. Нейната мрачна, но и проницателна същност ражда нови технологии и развива други, тлеещи и прикрити, чакащи търпеливо бурята на своето появяване. Компютрите се появяват тогава, в този вид, в който са ни известни и днес – програмируеми, електронни, бързи и преобразяващи нашата история.

4. Забунов, С. Безпилотните летателни апарати в помощ на природата и човека. *Списание Природа, БАН*, Издание №4, 2015г.

Резюме

Желанието на хората да летят олицетворява тяхната свобода да се въздигат над света и над пороците в него, над грозотата и болестите, над войните и страданията. Полетът е радост, а да сътвориш летателна машина е едно от онези несравними удоволствия, така пристрастяващи и в същото време така чисти, че веднъж научил се да лети, човекът се ражда в нов свят на безгранична независимост.