

В работе проведено исследование изгиба тонкой круговой пластины, находящейся под действием постоянной равномерно распределенной нагрузки гравитационного типа. При условии малости величины прогиба по сравнению с радиусом самой пластины построено уточненное приближенное аналитическое решение поставленной задачи с учетом геометрической нелинейности.

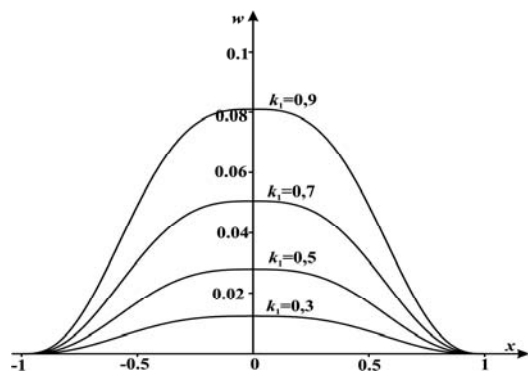


Рис. 2. Формы изгиба тонкой круговой пластины при различных значениях безразмерной нагрузки  $k_1$ . Масштаб по осям 1:10

#### Библиографические ссылки

1. Рекач В. Г., Кривошапко С. Н. Расчет оболочек сложной геометрии. М.: Изд-во УДН, 1988. 176 с.
2. Вольмир А. С. Устойчивость деформируемых систем. М.: Наука, 1967. 984 с.
3. Феодосьев В. И. К расчету хлопающей мембраны // ПММ – 1922. Т. X, № 2. С. 295–300.
4. Шкутин Л. И. Численный анализ осесимметричных форм выпучивания радиально сжатой пластины //

Изв. Вузов / Сев.-Кавк. регион. Естеств. науки. Спецвыпуск: Нелинейные проблемы механики сплошных сред. Ростов н/Д: Изд-во Ростов. ун-та, 2003. С. 299–304.

5. Шкутин Л. И. Численный анализ осесимметричных форм выпучивания пластин при радиальном сжатии // ПМТФ – 2004. Т. 45, №1. С. 107–114.

6. Захаров Ю. В., Охоткин К. Г., Устойчивость тонкой круговой пластины при радиальном сжатии // ДАН – 2001 г. Т. 377, № 6. С. 764–768.

7. Алексеева Е. И., Горбунов А. И., Крамаренко Е. Ю., Левина Е. Ф., Райхер Ю. Л., Степанов Г. В., Столбов О. В. Деформация плоской мембраны из ферроэласти, закрепленной по ободу, в однородном магнитном поле // Зимняя школа по механике сплошных сред – 2007. Ч. 1. С. 31–34.

#### References

1. Rekach V. G., Krivoshapko S. N. *Raschet obolochek slozhnoy geometrii* (Calculation of shells of complex geometry). Moscow, Izd-vo UDN., 1988. 176 p.
2. Vol'mir A. S. *Ustoychivost' deformiruemykh system* (Stability of deformable systems). Moscow, Nauka, 1967. 984 p.
3. Feodos'ev V. I. *PMM*, 1922. vol. X, no. 2, pp. 295–300.
4. Shkutin L. I. *Izv. Vuzov. Sev.-Kavk. region. Estestv. nauki. Spetsvypusk: Nelineynye problemy mekhaniki sploshnykh sred*. Rostov-na-Donu, 2003, pp. 299–304.
5. Shkutin L. I. *PMTF*, 2004, vol. 45, no. 1, pp. 107–114.
6. Zakharov Yu.V., Okhotkin K.G. *DAN*, 2001, vol. 377, no. 6, pp. 764–768.
7. Alekseeva E. I., Gorbunov A. I., Kramarenko E. Yu., Levina E. F., Raykher Yu. L., Stepanov G. V., Stolbov O. V. *Zimnyaya shkola po mekhanike sploshnykh sred*, 2007, ch. 1. pp. 31–34.

© Захаров Ю. В., Охоткин К. Г., Пашковский А. В., Скоробогатов А. Д., Уваев И. В., 2013

УДК 802:378.4

## ИСПОЛЬЗОВАНИЕ НОВЫХ ИНФОРМАЦИОННО-КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ В ОБУЧЕНИИ ИНОСТРАННЫМ ЯЗЫКАМ СТУДЕНТОВ ТЕХНИЧЕСКИХ СПЕЦИАЛЬНОСТЕЙ

Н. В. Ивлева, Е. В. Фибих

Сибирский государственный аэрокосмический университет имени академика М. Ф. Решетнева  
Россия, 660014, Красноярск, просп. им. газ. «Красноярский рабочий», 31  
E-mail: natalie\_ivleva@mail.ru, fibichev@mail.ru

Рассматриваются новые методы повышения эффективности преподавания иностранных языков студентам технических специальностей с использованием информационно-коммуникационных технологий, а также их практическое применение на базе Ресурсного центра иностранных языков Сибирского государственного аэрокосмического университета имени академика М. Ф. Решетнёва. Внедрение информационно-коммуникационных технологий в учебный процесс основывается на языковой образовательной самостоятельности студентов, что способствует более продуктивному развитию языковой компетенции у студентов и будущих специалистов в определенной отрасли технических знаний в целом.

Ключевые слова: информационно-коммуникационные технологии, Интернет, информация, образование, дистанционное обучение, языковая компетенция, образовательная самостоятельность.

## USE OF NEW INFORMATION AND COMMUNICATION TECHNOLOGIES IN TEACHING FOREIGN LANGUAGES TO TECHNICAL STUDENTS

N. V. Ivleva, E. V. Fibikh

Siberian State Aerospace University named after academician M. F. Reshetnev  
31 "Krasnoyarskiy Rabochiy" prosp., Krasnoyarsk, 660014, Russia  
E-mail: natalie\_ivleva@mail.ru, fibichev@mail.ru

*The article reveals new methods of effectiveness increase in teaching foreign languages to technical students using information and communication technologies and their practical implementation at the premises of the Foreign Languages Resource Center of Siberian State Aerospace University. Adoption of information and communication technologies to the educational process is based on students' independent language learning that encourages more productive development of language competences mastered by students and future specialists in a special area of technical knowledge as a whole.*

*Keywords: information and communications technologies, Internet, information, education, distance learning, language competence, independent learning.*

In recent years in the field of education more and more importance is being attached to training of specialists capable of adapting to new tendencies in the world development and headlong growth in information and communications technologies (hereinafter referred to as ICT). Having a good command of a foreign language plays a significant role in this question due to the fact that in conditions of globalization and development of integration processes on various stages (economy, politics, culture) the language becomes the most important tool providing the successful adaptation in the society and demand as a specialist on the labor-market.

The quality of training in the field of foreign languages depends on plenty of factors: qualification of the teaching staff; quality of the training and methodological materials; material and technical basis; coordinated work of all involved departments [1].

The Krasnoyarsk territory still lacks for the generalists with good knowledge of foreign languages in their professional sphere and also highly skilled staff in the field of philology capable of training at all stages of foreign languages learning: school – institute of higher education – professional activity. It is stipulated not only by a large area of the Krasnoyarsk territory and remoteness of settlements from the territory center but also by the low quality of training and methodological materials and impossibility of getting competent consultation from a specialist in the field of philology and foreign languages training methods. This fact does not favor the image raise of the territory in contemporary conditions of globalization and internationalization of the world economical and political processes.

The formation of the United European Space of higher education, initiated by signing the Bologna Declaration, led to serious reappraisal of approaches to aims and objectives realized by the existing system of educational institutes. In this connection one of the main objectives of Russian higher professional education is staff training for new generation – specialists having fundamental grounding and actively reacting to changes on the labor-market. The question arose more crucially about the

language training of the higher school staff – scientists, engineers and technicians who are called to develop and hasten the technical progress. Knowing a foreign language as a tool of the professional activity can and even must improve chances of the Russian specialists on the world labour-market. This activity includes contacts with foreign colleagues, acquaintance with the contemporary world achievements and their usage in the professional practice.

Nowadays, in the information-oriented society foreign languages teachers have new effective training tools about which it was possible to dream only before – ICT. The advantages of ICT adoption are, firstly, acceleration of knowledge transmission and accumulated technological and sociological human experience not only from generation to generation but also from one man to another; secondly, contemporary ICT increasing the quality of teaching and education allow people to adapt to the environment and social changes more successfully and quickly. It gives every person a possibility to get necessary knowledge at present and in the future information-oriented society; thirdly, the active and effective adoption of these technologies in education is an important factor for creation of the educational system meeting the demands of the information-oriented society and process of traditional educational system reformation in the light of demands of the contemporary society.

The main advantage of new ICT adoption lies in expanded access to education, the system of open education formation, creation of job descriptions for contemporary specialists. The aim of ICT adoption for teaching foreign languages on the basis of Foreign Languages Resource Center of SibSAU on the contemporary stage is the development of the students' communicative competence, ability to intercultural communication and use of a foreign language as a tool of this communication [7], also the development of the linguistic independence in the educational process which would favor the further perfection of intercultural communication and increase the level of cognitive activity via learning a foreign language. The basic

objectives of ICT adoption for teaching foreign languages on the basis of Foreign Languages Resource Center of SibSAU are the increase of the specialist training quality by means of using contemporary ICT in the educational process; use of active teaching methods and, as a result, increase of creative and intellectual components of training activities; integration of different kinds of the training activity (studying, research, etc.); adaptation of information technologies to individual features of students; continuity and succession provision in learning; development of information technologies for distance learning; improvement of program and methodological materials for the educational process.

According to the aim of the Foreign Languages Resource Center of SibSAU and experience in teaching foreign languages in a non-linguistic institute of higher education not only should a specialist possess developed communicative but also intercultural competence to behave in situations of intercultural communication without any difficulty, take part in them and decide the issues. «...ability of an individual to fulfill himself in conditions of intercultural interaction» (Galskova et al, 2005, p.18), which supposes, first of all, the development of students' linguistic independence in the educational process, favoring the further perfection in intercultural communication and cognitive activity via learning a foreign language.

There are quite a lot of ways to develop students' education linguistic independence, however, not all of them meet the needs of contemporary students and reveal all their possibilities in learning foreign languages. According to tutors-researchers of this problem there were lots of ways for developing this kind of independence tested. Some ways, the basis of which is ICT as the most effective tool of learning foreign languages, were selected and joined in one group.

One of the most valid tools of students' educational linguistic independence development involving ICT is courseware adoption for the educational process. There are a number of various approaches to classification of courseware but there is no common opinion and, consequently, common classification. This courseware can be classified being based on aims and objectives of the courseware or modes of using it: illustrating, consulting, operational environment, simulators, training examination; also it is possible to classify it being based on the analysis and generalization of different classifications: training, tutorial, problem-solving, imitating and modeling, playing. All mentioned classifications of the courseware can be referred to three forms: electronic textbooks, automated courseware, testers. Adoption of any form for the educational process defines the level of students' independence.

Use of electronic textbooks stimulates mastering the educational course or its sections with the help of a tutor or without. An electronic textbook can be tended for independent learning or lecture support with the view of advanced study. The textbooks of this kind can be used by students while learning their special subjects in English. In connection with integration of processes in the society

interdisciplinary connection plays an important role thanks to which it is possible to study one subject via another, in this case studying special subjects via foreign languages.

Automated courseware is a complex of scientific, methodological, training and organizing support for the educational process which is based on information technologies. Nowadays, thanks to automated courseware it is possible to solve some problems of education.

The first group can represent the problems related to the knowledge level, abilities, skills examination of students before and after education, finding out individual features, inclination and motivation. For such examination special psychological test systems and examination questions are used. The problems concerning students' capacity for work are solved by means of identification of a promptitude, level of attention, etc.

The second group of problems is connected with registration and statistical analysis of indexes referred to mastering training material: establishment of individual sections for every student, definition of the time limit for completing the objectives, definition of the total quantity of mistakes, etc. It is also logical to relate objectives concerning training activities management. Thereby, this group of problems is aimed at supporting and realizing basic elements of programmed training.

The third group of problems is connected with material preparation, its adaptation for different levels, presentation to students and preparation of dynamic illustrations, tasks, laboratory works and tests.

Hardware for this automated courseware is founded on local area networks including automated workplaces for students, tutors and circuits between them. The workplace for a student except for a monitor and keyboard can have a printer, multimedia elements such as speakers, voders, word processors and graphics editors. The aim of these hardware and software consists in supplying students with tools for problem-solving, reference materials and answer logging.

Automated courseware use in teaching foreign languages is also the way of linguistic independence development. The adoption of such ware to the educational process can help track students' training material mastering and also support students' independence on a tutor. Thanks to the ware of this kind it is possible to keep balance between students' independence and activity control.

Testers are related to the courseware too. The programs are developed with the help of a tutor for the purpose of facilitating the examination in course sections. However, it is worth paying attention to the fact that any test as an instrument should be defined by the reliability and validity indexes. Before having a test a tutor should know to what extent the test meets the abovementioned needs. The shells of many testers are developed in the following way: a tutor without special education in information technologies can make tests in an electronic form, testing them in some groups of students. Examination of this kind can simplify the check-up of completed tasks and also improve the estimation

objectivity. This examination is typical for taking exams on the international level. The example is international exams in the English language such as KET, PET, BEC, TKT, etc. which are set up by the Cambridge University Examining Board. For such exams the specific shells are installed into the site by means of which testing is organized. This form of examining is convenient for both a tutor and a student. Especially, if the test centers are far away from each other and the central office.

Thereby, it became possible to use this courseware for classroom and independent activities, examination. It improves the level of educational linguistic independence and motivation for learning foreign languages.

Electronic libraries are considered to be one more effective way for developing educational linguistic independence with the view of searching for authentic materials for completing different tasks while learning foreign languages.

Though, it is necessary to notice that before offering students to use the resources from the electronic libraries a tutor should analyze the resources of these libraries himself. The analysis can be performed with the help of the criteria for assessing educational networks, developed by the methodologist Shapiro K.V. from St. Petersburg. These criteria were developed in accordance with all parameters of electronic resources, consequently, analyzing them it is possible to be sure in the quality of resources which are offered to students. Nevertheless, for increasing the level of independence not only can students find appropriate materials in the selected libraries but also they can analyze the resources according to the same criteria to choose a good one.

One more way for developing students' linguistic independence is adoption of the project activity to special subjects in a foreign language with the help of ICT. In this activity it is possible to track the interdisciplinary connections between special subjects, information technologies and also a foreign language.

In terms of experience success in teamwork of students and tutors depends on organization of the activity. It is known that during the classroom work a tutor is more active than students while the students' activity appears in organization of independent work. The most actual problem for tutors is to organize independent activity to improve students' motivation. As the language is the means of communication and the speech is the way for this communication [9], mastering the tools is possible only in conditions of educational problem-solving situations. It means that it is necessary to define lessons where students use the tools for communicative tasks and lessons where they learn how to use these means in the training system [4]. Teaching communication is the interaction with a tutor in the frame of communicative cooperation. It is better to do preparatory work for this interaction, completing routine tasks, in the form of independent work. Linguistic tools should be mastered in the context of independent activities. Consequently, the center of physiological and pedagogical work should be focused on creating favorable conditions for students [8].

The questionnaire and interview of students showed that the process of getting experience in communication with a foreign culture demands the situations for practical language use as an instrument for intercultural knowledge and interaction. In connection with abovementioned facts it became objective to integrate such information technologies in the educational process which would allow to involve students in intercultural communication. Nowadays, the global network Internet presents a good range of possibilities for students' entry into authentic intercultural interaction with representatives from foreign countries; under such conditions the factor of no small importance is using low-cost technologies in teaching foreign languages.

On the basis of the foreign experience in teaching foreign languages using new information technologies [5] and ICT applied in the higher school of Russia there were synchronous communication tools and asynchronous communication tools adopted.

Synchronous communication tools are the Internet tools which allow communicating in real time (chat, video chat and audio chat). The examples of such tools which provide synchronous communication by means of chat, voice and video connection are Skype и Yahoo Messenger: <http://www.messenger.yahoo.com>, <http://www.skype.com>. Yahoo messenger and Skype users have the chance to determine immediate voice and video connection with a receptionist locating in any place in the world having these programs or communicate via chats. Also the programs allow to create a list of friends and invite them for a face-to-face chat or organize a conference, a group chat as it is called, set parameters of the search (age, sex, place of abode, mother tongue, interests, etc.) and find friends in the cyberspace.

These chat platforms open up new possibilities in teaching foreign languages. Using chats and voice connection is a good way of having lessons with students from other countries in the form of projects; discuss problems with competent representatives of other countries; offer original tasks. For example, for making first linguistic contacts with native speakers, having set parameters of an interlocutor, use the program, find an interlocutor in a certain country. It is a great chance to learn his name, interests, tell him about yourself, etc. and thanks to the function of chat text archiving it is possible to analyze the chat log from the point of grammar, vocabulary, punctuation, stylistics, speech mistakes, etc. and arrange new forms of lessons. Although these means of the Internet communication appeared not for a long time ago, in the world practice there is certain experience of their use in the educational process. Daphna Gonzalez, professor of Simon Bolivar University in Caracas, Venezuela, selected 5 types of the pedagogical chats: free topic chats; collaborative task-oriented chats; academic seminar or presentation chats; practice chats [3].

Asynchronous communication tools are the Internet tools which allow information exchanging with time delay (blogs, forums, educational portal, electronic and voice mail, web-sites, wiki, etc.).

Blog is a journal or diary written for public viewing on a website and consisting typically of personal reflections, commentary on current events, etc. arranged chronologically. Blogs can be updated daily / weekly / monthly. The developer of a blog has got the right to allocate information in his blog and edit it while the guests of the blog have got the right to comment on the articles only. A developer can allocate photographs, audio and video materials, web-links, etc. in his blog. Eron Campbell selected 3 types of blogs used in teaching foreign languages: the tutor blog, for example, <http://juliayats.blogspot.com>; the class blog; the learner blog [6].

Among blogs there is a special type of them – audio blogs or as they are called podcasts. The English word Podcast came from the words i-Pod (MP3 player) and broadcast. Audio blogs / podcasts are the network diaries but with MP3 files. Podcasting is creation and distribution of MP3 files in the Internet which can be listened on-line or loaded in a MP3 player. There are various types of podcasts: authentic podcasts, files with recorded native speech, for example, <http://www.podcastsinenglish.com>; podcasts developed by tutors for students; students' podcasts, for example, <http://juliay.podomatic.com>. Audio blogs open up great possibilities: any student may record his speech on the site using site tools and also allocate wave files, recorded in other programs, for example, Audacity and HandyBits or load from a CD but in the MP3 format.

Forum, originally a Latin word, currently refers in English to a place or a space for meeting or for trading. An Internet forum, also known as a message board or discussion board, is a web application that provides for online discussions, and is the modern descendant of the bulletin board systems and existing Usenet news systems that were widespread in the 1980s and 1990s. An Internet forum typically exists as part of a website and invites users to start topics and discuss issues with one another. Sometimes, a forum even comprises most, if not all, of the content of a site.

Compared to wikis, Internet forums don't allow users to edit the forum posts of other users; however, administrators and moderators generally have the capability of doing this. Internet forums differ from weblogs. The forums generally allow most users to post topics, while blogs only allow one or a few users to create entries. Forums also tend to be more diversified in interest, while blogs tend to be more specific to a certain topic or a subset of beliefs.

By means of Chinswing (<http://www.chinswing.com>), Gabmail (<http://www.freegabmail.com>) and Vaestro (<http://www.vaestro.com>) it is possible to arrange forums in foreign languages for Russian students and native speakers. In these forums different topics, exciting students, would be discussed, friendly relations would be established, speaking skills would be practiced.

Foreign Languages Resource Center of SibSAU gave an opportunity for tutors of foreign languages, students and inhabitants of Krasnoyarsk and Krasnoyarsk territory who are interested in languages and cultures to use all

new methods and technologies in teaching and learning foreign languages on the international level.

Cooperation with company Microsoft enabled tutors and students to get access to the education portal Live@edu, adopt and use it as an international educational net which permitted them to work with native speakers in an interactive mode.

Foreign Languages Resource Center developed the unique English and German electronic catalogue "Cat.edu" which includes full-text materials in categories: business and management, foreign languages for specific purposes, intercultural communication, linguistics, exam preparation materials, methodology, study skills, reference books, country study, fiction; courseware, video and audio material.

The center cooperates with publishing companies which present up-to-date literature. In the center it is possible to get access to full-text authentic documents, the newest researches and publications, materials for information and linguistic supply, authentic sources in the field of contemporary researches, collected in a catalogue. This access helps make up for the lack of information in the field of foreign languages for specific purposes and also helps be the support for more qualitative systems of professional training, retraining and professional development for the faculty, students, schoolchildren and everyone who wishes to learn languages.

Integration of ICT (Skype, Yahoo Messenger, Electronic Mail Service, chats, blogs, educational social nets, video conferences, etc.) in the educational process allows to solve a range of didactic problems more effectively: formation and improvement of reading, writing, speaking and listening skills; dialectic statement skills; active and passive vocabulary, moreover, students can find opportunities to get to know with sociocultural reality of a foreign language (speech etiquette, features of speech behavior and culture, traditions of foreign countries) and raise motivation for foreign activities on the basis of authentic materials and principles connected with the real life.

ICT open up possibilities for direct authentic communication between speakers. These new possibilities cannot be compared with traditional forms of work because of their diversity, transfer rate, special independence and content. They actively involve students in a linguistic environment and help get over the language barrier, encourage topic discussions in a foreign language outside regular hours with native speakers in real time and with time delay, stimulate creative activity, motivate for learning foreign languages and cultures, improve communicative and intercultural competences and also familiarize students with net resources which offer a lot of interesting and useful information for problem-solving tasks during lessons.

However, it is necessary to offer all facilities for learning. The facilities by means of which students feel their progress, intellectual consistency and make the process of learning more productive.

Independent information search is a constituent part of the creative process which livens up the intelligence

activity of individuals. The search at the moment of the concept appearance can stimulate the concept development and prevent from its disappearance. ICT make people solve different problems in a new way, change the way of thinking. Surfing the Internet students feel themselves as parts of the “teaching” family, where people speak different languages. This fact impels students to learn more than one foreign language.

Integration of ICT in the educational process leads to reconsideration of a teacher’s role and place in this process. The basic objective of this process is not knowledge transmission or ability and skill formation but interest encouragement, motivation for language learning, help in adoption and creative research. Nowadays, relations with students are built on principles of cooperation and joint search and creativity.

In these conditions it is inevitable to reconsider and review present forms, principles and methods of teaching: there are tendencies in independent work and team work increase, deviation from traditional forms of lessons, illustration methods use in teaching, increasing the volume of practical and creative work with searching and research features. Internet technologies are called to favour the development of the individual educational paths: to adapt the educational material to individual features of students, their level of knowledge and abilities.

Having studied the problem of using ICT in teaching foreign languages it is possible to state that the linguistic community having understood the potential of ICT actively develops the ways of increasing the effectiveness in teaching foreign languages in non-linguistic institutes

of higher education and according to the experience ICT use in teaching raise the level of quality and preparation of future specialists.

### References

1. Chuchalin A. I., Veledinskaya S. B., Royz S. S., Okhotin I. S. “Modeling Process of Foreign Training in the Institute of Higher Education from the Point of Quality Management”, *Engineering Education*, 3 (2005).
2. Galskova N. D., Gez N. I. “Foreign Languages Teaching Theory” (Moscow, 2005).
3. Gonzalez D. “Teaching and Learning through Chat: a Taxonomy of Educational Chat for EFL/ESL”, *Teaching English with Technology*, 4 (2003).
4. Mashbits E. I. “Computerization of Education: Problems and Perspectives” (Moscow: Pedagogy, 1986).
5. Polat E. S. “Some Conceptual Regulations for Foreign Languages Distance Teaching on the Basis of Computer Technologies”, *Foreign Languages at School*, 5 (1998), pp. 6–11.
6. Stanley G. “Blogging for ELT” (Barcelona: British Council, 2005).
7. Sviridon R. A. “Intercultural Education in Contemporary Conditions”, *Actual Problems in Teaching Foreign Languages at Schools and Universities*, ed. by V.I. Petrishev (Krasnoyarsk: KSPU, 2008), pp. 9–11.
8. Tyukova A. A. “Problem-solving tasks in professional training of students”, *Problem-solving Education in the Institute of Higher Education* (Moscow: Knowledge, 1986).
9. Zimnyaya I. A. “Psychology of Teaching a Foreign Language” (Moscow : Russian Language, 1989).

© Ivleva N. V., Fibikh E. V., 2013

УДК 629.7.05

## ПРОГРАММНЫЙ КОМПЛЕКС МОДЕЛИРОВАНИЯ СТАБИЛИЗИРОВАННОГО ДВИЖЕНИЯ КОСМИЧЕСКОГО АППАРАТА С ТРАНСФОРМИРУЕМЫМИ УПРУГИМИ ЭЛЕМЕНТАМИ КОНСТРУКЦИИ

М. Г. Игнатьев, В. М. Копылов, А. Ю. Кулаков, М. В. Сотников

ФГУП «КБ «Арсенал»

Россия, 195009, Санкт-Петербург, ул. Комсомола, д. 1-3. E-mail: michigna@mail.ru

*Представлен программный комплекс, используемый для моделирования движения КА с активной системой управления движением (СУД). Комплекс предназначен для оценки функционирования СУД, определения влияния изменения технических характеристик приборов и исполнительных органов СУД, а также для проверки правильности определения коэффициентов управления с учетом упругости конструкции КА. Рассматриваются алгоритмы расчета упругих колебаний, смещений узловых точек гибких элементов, а также расчета сил и моментов от аэродинамического и светового давления.*

*Ключевые слова: система управления движением, математическая модель КА, протяженные упругие элементы конструкции.*