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ROBOTIC SYSTEMS IN STATIC AND DYNAMIC TESTING OF COMPOSITE MATERIALS PRODUCTS

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Keywords: composite materials, testing of products from composite materials, robotic systems.
Abstract. In this article, the authors consider the prospect of raising the quality of production of composite materials used in the rocket and space industry, through testing and research on static and dynamic characteristics using robotic systems.

РОБОТОТЕХНИЧЕСКИЕ СИСТЕМЫ В СТАТИЧЕСКИХ И ДИНАМИЧЕСКИХ ИСПЫТАНИЯХ ИЗДЕЛИЙ ИЗ КОМПОЗИЦИОННЫХ МАТЕРИАЛОВ

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Ключевые слова: композитные материалы, испытания изделий из композиционных материалов, робототехнические системы.
Аннотация. В данной статье авторами рассмотрена перспектива поднятия качества производства изделий из композитных материалов, применяемых в ракетно-космической отрасли, посредством проведения испытаний и исследований на статические и динамические характеристики с применением робототехнических систем.

A modern spacecraft is a complex technical system that includes a power structure, attachments, power supply, orientation, stabilization, relay subsystems, and mechanical devices for separating and deploying antenna reflectors and solar cells. And, increasing requirements for reliability, ensuring non-destruction and normal operation of the spacecraft lead to the need to develop new solutions to ensure compliance with the technical condition of the spacecraft [1].

One of these solutions is the introduction of materials of a new level of performance properties, among which the leading role, of course, belongs to composite materials (CM). Such materials have a number of unique properties and characteristics (strength, deformation, shock, elasticity, temperature, adhesion, electrical, friction, heat-conducting, etc.) that are not typical for the original components and "classic" materials [2]. Note that the production of products from CM has a number of advantages: versatility; the ability to produce products of complex shapes and large sizes; low cost of tooling; the ability to create layered structures, including embedded parts; suitability for pilot production. However, there are also disadvantages: high manual labor costs; low productivity; "buoyancy" of product quality; difficulty in ensuring the uniformity of the material and the stability of its physical and mechanical properties [3]. And, to solve a number of such shortcomings, it is important to use a robotic complex-not only as an automation tool, but also as a tool that can be focused on identifying design and production and technological defects. This approach gives the prospect of more objective control and reliable evaluation at the stages of pilot and serial production.

Testing and control through the use of robotic systems based on the principles of recognition, retention, tracking and movement of the object, together with systems designed to obtain information and its subsequent analysis, will allow you to identify defects and detect deviations from the corresponding calculated values, or from the values obtained earlier during tests of similar products.

The most basic (often performed) tests are tests for static and dynamic (fatigue) characteristics of the product, for example: tests that allow you to identify defects associated with a statistical spread of the stiffness and strength-resistant properties of the product, which is under the influence of short-term and long-term shock or pressure loads. Drawing attention to the fact that such tests are products of MILES, the test results may be determined by such parameters as: the degree of plasticization and glass transition, degradation of the mechanical properties of the product when exposed to aggressive or undesirable conditions and environments, the degree of transition from micro to macronutrients, etc. Also, the use of robotic systems will allow to reveal defects without trying might be forced to eliminate the influence of other factors, and in addition, will provide an opportunity to assess them. Such factors can be understood as resonant frequencies, forms and damping coefficients of natural vibration tones, amplitude-frequency and phase-frequency characteristics, spectral power densities of random vibration, etc. [4]. In addition, it is possible to conduct tests in imitation of the conditions and environments to which the spacecraft is exposed in outer space without any significant and additional requirements for robotic systems, which will help to get rid of a number of existing technical and organizational difficulties that require close and continuous monitoring. Also note that robotic systems allow you to automate the process of testing, data collection and processing, which is certainly an advantage.

The use of robotic systems not only as a tool aimed at identifying structural and production and technological defects in CM products or automation tools, but also as a tool that allows research to identify certain design features, makes it possible to predict the stiffness and strength-resistant properties of the future product at the prototyping level. Accordingly, this perspective allows you to apply the results of research at the design stage of the future product, which certainly improves the quality of production of products from CM from the design stage to the final product.

The advantage of using robotic systems is that they have a huge versatility, i.e. they can be assigned a more significant role in production. The robotic system can be easily modified or converted to perform related or other tasks. Presumably, one complex with a robotic system can take over the development of almost all the main tests and bring products from KM to full readiness. An important advantage of such systems is their automation and high accuracy.

At the moment, there are pilot plants based on an industrial robot designed for testing products from km. the Maximum percentage of participation of such systems is not large. And the purpose of using these systems affects only the process of automation of narrowly focused tests.

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