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Vitalii Chitak**PRINCIPLES OF ADVANCED COMPUTER-AIDED TECHNOLOGIES APPLICATION IN INFORMATIONAL SUPPORT OF TECHNOLOGICAL PREPARATION OF PRODUCTION OF NATIONAL CIVIL AIRCRAFTS**

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Abstract

The overview and analysis of the issue of computer integrated technologies application in automated design engineering of preparation of production of national civil aircrafts have been made. Basic principles of such technologies' application as one of the conditions of providing high-productive aircraft-building production have been proposed.

Keywords: civil aircraft; technological preparation of production; computer and information technology; principles of implementation

1. Introduction

Computer-aided technologies of virtual reality and visual simulation have been applied in leading foreign aircraft-building companies since 80ies. Currently, similar systems are widely used in the process of designing, technological preparation of production and in the shop-floor production of aviation equipment.

One of the pioneers in applying virtual reality in the aircraft-building industry is the Boeing Company. Virtual reality systems in the Boeing Company are used at all stages of the aeronautical products life cycle starting from the concept design, engineering and technological elaboration of the construction and finishing with visualization systems for consumers of the corporation's products. Virtual reality systems used in the corporation are the products of their in-house design.

2. Analysis of the latest research and publications

The Boeing Company is also a pioneer in the new area – the augmented reality (AR, augmented reality) systems. This class of systems is designed to combine real world objects and digital models. By way of example of practical application of this technology in aircraft-building, the mold-loft free and reference standard-free aggregate assembling of

the product may be taken when the required technological operations are shown digitally over the real product in the workshop on specialized glasses of an assembly worker or on his mobile terminal.

The AR-technologies are commonly used in the aggregate assembly process of aeronautical products, their operation, maintenance and repairs. Besides the Boeing Company, the virtual reality technologies are widely used in aircraft manufactures like Airbus, Embraer, Dasso aviation and other major aircraft manufacturing companies.

The works [1-4] and other have greatly contributed in development of theoretical grounds of building automation systems and achieving practical results in certain areas of technological preparation of production.

The works were carried out in the areas as follows:

- automation of design of manufacturing processes;
- automation of NC code development for the equipment with computerized numerical control;
- automation of design for technological equipment;
- visualization and verification of automated processing processes;
- automation of preparation and adjustment of the tool;

- implementation of systems of distributed control of the equipment with computerized numerical control;
- automation of tests results control and processing.

Significant results have been achieved in automation of technological preparation of production of aeronautical parts by methods of excessive metal removal, since the key operations of mechanical treatment have been well formalized and are easy to be modelled by graphic solid-body images. The equipment with computerized numerical control is used in the aircraft-building industry in several areas: to produce parts, equipment and forms and sizes medium.

The scientists of the National Aerospace University named after N.E. Zhykovskiyi "Kharkiv Aviation Institute" have made considerable progress in development of theoretic aspects and implementation of informational technologies in the national aircraft engineering. Back in 90ies of the previous century, the computer-aided technology at an assembly plant in the part of modelling and optimization of aircrafts assembling was applied by this author [5]. Since the early 2000ies, the National Aerospace University named after N.E. Zhykovskiyi "Kharkiv Aviation Institute" saw extensive implementation of scientific researches, which resulted in qualifying papers release [6-7].

The works [8-9] summarize the researches in the field of technological preparation of production in the context of discretely instable programs of aircrafts production existing in the early 2000ies.

The work [8] shows the new concept of technological preparation of aircraft production under conditions of dependent receipt of connected parts sizes, with such concept being based on analytical reference standard generated by engineering computer-aided software. Under this concept the methodologies of technological preparation of production have been developed for:

- parts manufactured by technology of primary fabrication;
- parts manufactured by stamping of composite materials;
- band heating elements of anti-icing system of the stabilizer block of An-140 aircraft.

These methods allowed for considerable reduction of the time for mastering serial production of An-140.

In [9] for the first time in the field of technological preparation of production based on

systemic approach, the method and fundamentals of technological preparation of production of aircraft manufacturing in the discretely unstable output programs have been developed, and it was proven that to improve the efficiency of technological preparation of serial production in the conditions given, the mold-loft and template method of copying of forms and sizes should be replaced with the method based on using the equipment with computerized numerical control and analytical reference standard.

Strict definitions of the concepts «collection» and «interchangeability» are given, differing from the existing ones. «Collection» is considered as the basic concept and «interchangeability» as resulting from «collection». New concepts have been introduced - such as «analytical standard», the manufacturability triad «design - technology - production - volume», the quality level triad «personnel - technical process - equipment», which make it possible to set more accurately the tasks of technological preparation of production.

For the first time, the criteria for the applicability of dependent and independent formation of the size of the assembly chain section were obtained.

The paper [6] is devoted to the problems of preparation and organization of aviation procurement and stamping production based on CALS-technologies. It explores and develops information models and algorithms for an integrated system of automation equipment design for technological preparation of blank and stamping processes of a modern aviation enterprise production in the context of a single information space.

Further development was given to the development of systems for intellectual support of technological decision-making in the creation of basic automation equipment for technological preparation of production in a single information space, as well as the basics of their operation in modern aviation enterprises with an assessment of technical and economic efficiency.

Numerous publications of the author are summarized in the paper [7] into a single scientific complex of studies on automated aggregate assembly of aircraft structures under conditions of pilot and single production. This work developed the concept of assembly production, a fuzzy-multiple approach to the robotization of the assembly of an airframe. The author conducted experimental studies of specialized re-adjustable

devices with numerical control and assembly process using robotic systems, adjusting the duration of the automated assembly process, as well as analyzed the economic efficiency of using automated aggregate assembly.

Analysis of these and other works allows us to state that they mainly formulated the concept and methods of developing an integrated system of interaction in real and virtual space with other subsystems of information support for the design and manufacture of high-quality aircraft units in a limited time frame with fixed costs.

In addition to these works, the discussed scientific direction was further expanded and developed in the works of Ukrainian researchers, in particular in papers [10-12].

The implementation of the principles and means of systemic application of integrated CAD technologies in CAD / CAM / CAE / PLM and virtual reality systems for technological planning of aggregate-assembly production of civil aircraft in the domestic aircraft industry at ANTONOV Company is carried out by the author of this publication.

It should be noted that the highly efficient production of civil aircraft is possible with concept and methods of using the basic principles of full intensive information support of technological processes implementation, first of all:

- the principle of system application of integrated information technologies of computer-aided design and virtual implementation systems for technological production planning;

- the principle of advanced launching into mass production of new aircraft and their modifications;

- the principle of using the equipment of the pilot production at the initial stage of the series.

The implementation of these principles seems to be the immediate problem.

The first of these principles integrates the determining components that form a single information space:

- methodology for the implementation of the system for designing and manufacturing devices during technological preparation of production in the virtual reality mode;

- the concept of using the software and technology complex in a virtual reality environment;

- the concept and methodology for designing the equipment for assembly plants based on an electronic design and technological layout in

CAD/CAM/CAE/PLM and virtual reality environments.

The concept and methods of using these three principles seem to be productive for the implementation of highly efficient production of civilian domestic aircraft.

Undoubtedly, this complex task is an essential part of the global multidimensional problem of scientific support for the creation of domestic civil aircraft, which, according to flight performance, correspond to world standards and are competitive in sales and services [13].

3. Conclusions

A brief analysis of the use of computer technologies of virtual implementation and simulation of technological processes of design and technological preparation of production of foreign aircraft and in domestic practice was done. The basic principles are formulated: system application of integrated information technologies of computer-aided design and virtual implementation systems for technological production planning; advanced launch into mass production of new aircraft or their modifications; use of equipment of pilot production at the initial stage of the series.

The implementation of these principles is the immediate problem of the formation of a highly productive production of domestic civil aircraft.

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В. Г. Чітак

Принципи реалізації сучасних комп'ютерних технологій в інформаційній підтримці технологічної підготовки виробництва вітчизняних цивільних літаків

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Проведено огляд і аналіз стану проблеми реалізації комп'ютерних інтегрованих технологій автоматизованого проектування підготовки виробництва вітчизняних цивільних літаків. Запропоновано основні принципи реалізації цих технологій як одна з умов забезпечення високопродуктивного літакобудівного виробництва.

Ключові слова: цивільні літаки; технологічна підготовка виробництва; комп'ютерні та інформаційні технології; принципи реалізації

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Принципы реализации современных компьютерных технологий в информационной поддержке технологической подготовки производства отечественных гражданских самолетов

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Проведен обзор и анализ состояния проблемы реализации компьютерных интегрированных технологий автоматизированного проектирования подготовки производства отечественных гражданских самолетов. Предложены основные принципы реализации этих технологий как одно из условий обеспечения высокопродуктивного самолетостроительного производства.

Ключевые слова: гражданские самолеты; технологическая подготовка производства; компьютерные и информационные технологии; принципы реализации

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