*Research Article*

# The Need To Use Geographic Information Systems In Air Traffic Control

**Dilshod E. Eshmuradov[1(*)], Anvar A. Sulaymonov [1], and Nargiza A. Sayfullaeva[2]**
[1] Tashkent State Technical University, Tashkent, Uzbekistan
e_dilshod69@mail.ru, dokavia101@gmail.com
[2] Tashkent University of information technologies, Tashkent, Uzbekistan
n.sayfullaeva07@gmail.com

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**ABSTRACT.** In the Republic of Uzbekistan, measures are widely carried out to assess the state of the telecommunications sector and the rational use of ICT based on GIS, the compilation and use of digital radio navigation graphic databases, the conduct of effective monitoring and automated air traffic control. The accuracy of ground-based radio navigation aids essentially depends on geodetic measurements, which are carried out in a certain coordinate system, and their final accuracy directly depends on the accuracy of the adopted coordinate base. Therefore, ensuring high accuracy of both measurements and their processing takes an especially important place in the construction of geographic information networks. However, the state geodetic network, if it is not systematically updated and improved, is gradually aging, loses some points, loses accuracy in some of its parts, esspecially due to modern movements of the earth's crust. air traffic. Special attention is paid to the possibilities of GIS in the compilation of radio navigation maps, the coordination of international flight control systems, the development of simulation models that allow efficient airport management.

**KEYWORDS:** flight, accuracy, navigation, communication, observation, logistics, management, GIS, airport, accuracy, map.

**INTRODUCTION**. The efficiency and safety of air transport control substantially depends on information support. Its current state is associated with the use, first of all, of information means of communication, navigation and observation [1]. At the same time, it should be noted that in recent decades, the problems of inconsistency in the use of these funds and their capabilities with modern requirements have become aggravated. Such requirements are determined by the level of security, economy and continuous availability of information support, as well as systems for rapid response to unforeseen situations.

It is necessary to pay attention to the fact that according to ICAO forecasts, an increased demand for the use of aircraft is expected in the next 5-7 years.

Current projections based on the 1995 level of traffic development show a more than doubling of commercial air travel across Europe by 2025 [2]. At the same time, according to experts, the air transport service and traffic control systems existing today in aviation will not be able to cope with such demand.

Therefore, today, in order to solve the problem of development and improvement of air traffic control systems, it is necessary to take into account the following factors:

- existing limitations of technical, economic, procedural, operational characteristics of flight control systems and opportunities for their improvement;
- size and maneuverability of aircraft;
- regulated or unregulated traffic flow in which aircraft or other vehicles are moving;
- skill level and workload of the staff;
- possible economic benefits.

In the context of the above, there is no doubt that air transport management should now be based on the use of intelligent transport systems (Intelligent Transport Systems) and intelligent logistics systems (Intelligent Logistics Systems), which are based on geoinformation, geoinformation technologies and geoinformation systems (GIS).

GIS already now allow providing all direct participants in air traffic control and each link of the transport system separately with the necessary high-quality and operational space-time information.

Therefore, taking into account the dynamic development of international aviation, as well as taking into account the forecast for an increase in the volume of air traffic and realizing the inevitability of the emergence of new technologies, the study of the possibilities of using geographic information systems for air traffic control is an important scientific and practical task, the solution of which is the purpose of this article

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**ANALYSIS OF PUBLICATIONS ON THE RESEARCH TOPIC**. The issues of effective organization of flights and servicing air traffic using GIS are increasingly reflected in the works of domestic and foreign scientists every year.

So the possibilities of creating a digital map of the area, which is integrated with an expanded database, are devoted to the works of such authors as: LiYafei, LiangChen, Helleset A., Sun, R.-s .; Yuan, D .; Xie, Z.-n, Chapman B., Kraus K., Waldhausl P.
In the studies of Scaini C., Folch A., Bolic T., Castelli L., the requirements for geospatial data of transport and navigation GIS used in aviation are considered.
The prospects for the implementation of an integral global air traffic management system based on GIS, which will allow aircraft to comply with the planned departure and arrival times, as well as to use preferential flight profiles with minimal restrictions and without reducing the established level of flight safety, are devoted to the work of a number of Russian scientists, among whom Ageev can be distinguished P.A., Kozlova S.Yu., Zaiku P.V., Kheilo A.Yu., Khaustova I.A., Ryleva S.S. and etc.
However, despite the existing publications and developments, the process of creating geographic information systems in the field of air transport management is only at the first stages of its development and requires further, in-depth research.
Thus, taking into account the above, the purpose of the article is to substantiate the need and consider the possibilities of using geographic information systems in air traffic control.

**MAIN PART.** Graphical experiments have noted "leaps" in location when switching from one DME transponder to another located in different states [3]. And these errors appear due to the incompatibility of the coordinates of ground vehicles. If the coordinates of a ground-based radar navigation aid are determined using two or more different geodetic reference datums, two or more different sets of latitude and longitude values will be obtained when establishing the horizontal position of the aircraft. Consider the discrepancy in the position of the aircraft, which is compiled in metric units of several hundred meters while simultaneously determining its position and tracking the track line by two radars: radar 1 and radar 2, tied to two different geodetic bases (Fig. 1).

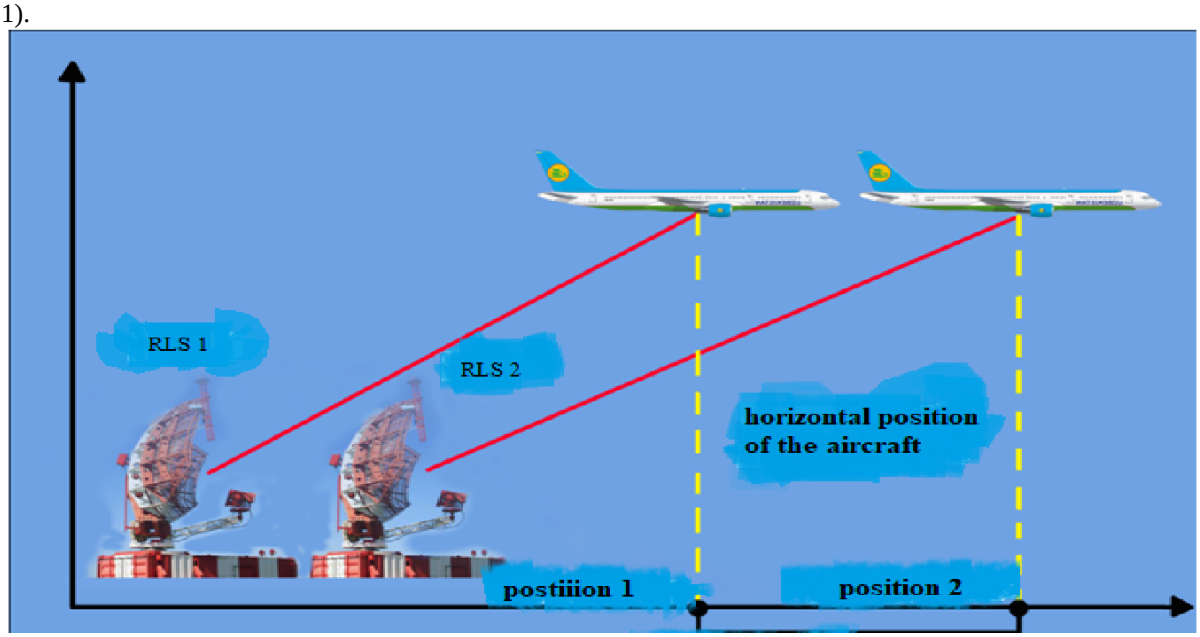


**Fig. 1 Tracking the track line with two radars**

This discrepancy could lead to a situation where an aircraft, located close to the border between two states using different geodetic reference frames, on the radar screens of the two states will have a different position, which can lead to misinterpretation of the separation between aircraft and the distance from the zone. flight restrictions. Thus, the main source of systematic errors is the failure to use a single geodetic reference base when determining the position using radars; The solution to this problem is to obtain radar position data using a single geodetic reference system.

Geographic information systems are a set of software, information and technical means [4], which provide the introduction, storage, processing, mathematical and cartographic modeling, as well as the integrated presentation of geographic data and other information.

**Mapping**

The use of GIS technologies in air traffic control makes it possible to solve a whole range of tasks that air navigation faces today. Most of the information used by air navigation services is geographic. Solving the problem of modeling air corridors, which was usually carried out by developing paper maps, using special computer programs based on electronic maps, radically changes the nature and efficiency of the work process.

Air traffic control systems operate with periodically changing information on routes, destinations, no-fly zones, which, during the modification, must be promptly reflected in special flight charts and diagrams. Aeronautical navigation also imposes very strict requirements on the accuracy of the produced cartographic products.

As is known, the radio navigation chart is one of the key documents of aeronautical information [5]. This document contains summary information about the terrain, the structure of the airspace, the location of the aerodrome, the geographical coordinates of its radio navigation aids and many other data necessary for air navigation and flight safety [6-9].

Traditionally, when developing and preparing for publication of a radio navigation chart, a lot of "manual" work is spent, which includes time for development, making operational measurements, and preparing charts for publication. GIS makes it possible to “automate” the process of creating and issuing the necessary documents, to improve their accuracy and quality, and to significantly reduce the time and material costs required for their issuance [10]. In fig. 2 shows an example of a radio navigation map built using GIS technologies.


Fig. 2. An example of a radio navigation map built using GIS technologies

a) Radio navigation chart of flights over St. Petersburg b) Drive radio station and air routes

International integration of air traffic control systems

In addition, the need to use GIS in air traffic control is due to the fact that traditional methods of increasing capacity by further expanding the number of airspace sectors have exhausted their capabilities and are not effective. The existing ATM (Air Traffic Management) air traffic management procedures and concepts are fundamentally limited, so they cannot serve the projected increase in air traffic and meet current user requirements.

Obviously, the indicated difficulties and limitations will be overcome by GIS, which open up wide opportunities for the use of existing and future technical means, and make it possible to implement new concepts and procedures for the development of additional air navigation infrastructure. In addition, it is necessary to focus on the fact that the processes of transition to a global communication, navigation, surveillance and air traffic management system are currently being actively implemented. This provides for the creation of a single global system based on GIS, the effectiveness of which will depend on the harmonization and standardization of regional and national elements of the system and procedures for its use.

Table 1 presents the expected results and benefits that the use of GIS in the air traffic control process will bring.

Table 1 Expected benefits of using GIS in air traffic control systems

| **Airspace management** |
|---|
| – improving flight safety;<br>– increasing the throughput of the control system;<br>– optimal use of airport capacity;<br>– reduction of waiting time and delays;<br>– reduction of operating costs for flights;<br>– more efficient use of airspace and increased planning flexibility, shorter separation intervals;<br>– dynamic flight planning;<br>– reducing the workload of dispatchers and increasing labor productivity.<br>– modernize the air navigation infrastructure of the region;<br>– use modern en-route and terminal navigation methods;<br>– ensure the processing and publication of aeronautical information in accordance with ICAO standards; |

| – to improve air navigation support of flights in order to improve the safety and efficiency of air transportation. | | |
|---|---|---|
| **Communication** | **Navigation** | **Observation** |
| – improving the efficiency of air-ground lines;<br>– improvement of data processing;<br>– reduction of channel overloads;<br>– reducing the number of errors when entering information;<br>– interaction of different applied processes;<br>– reduction of workloads. | – holistic, highly reliable, all-weather navigation service on a high-tech basis;<br>– improving the accuracy of navigation in space and time;<br>– cost savings as a result of decommissioning ineffective navigation aids;<br>– more efficient use of airports. | – reducing the number of errors in location messages;<br>– cost savings;<br>– surveillance in non-radar space;<br>– efficient response of dispatchers to a change in flight profile;<br>– control over the implementation of instructions;<br>– more effective assistance in emergency situations. |

Airport management

In connection with the intensification of flights, the expansion of the fleet of used aircraft, it is obvious that the airport control system (AP) becomes more complicated, which is due to the influence on its functioning of many random factors, such as meteorological conditions, errors of air navigation systems, aircraft delays, altitude features of the terrain, errors of the operator. staff, etc.

There is no doubt that for the analysis of such a complex system, it is advisable to use statistical and simulation geoinformation modeling of the current situation on / over the territory of the AP and in the adjacent zones, which will allow predicting the possible consequences of certain managerial actions and taking more accurate, reliable and safe solutions. The geoinformation component of the modeling process should be provided by the availability of electronic aeronautical charts, the list of which is determined depending on the main stages of the aircraft flight in the ICAO documentation.

**CONCLUSION**. Thanks to geoinformation modeling, it is possible to build a simulation model that will contain both static elements, represented by a cartographic background, and dynamic components, which are symbols of objects moving in near-earth space.

The following elements can be used to represent the current situation in the automated control system of the AP:

- a system for processing and visualizing images of the airport territory and the surrounding area at different scales;
- a system for processing and representing all moving objects in the form of symbols on the cartographic background of the controlled area of space;
- system of detailed display of dynamic scenes of aircraft flight.

Thus, the need for the use of geographic information systems in air traffic control is due to the task of creating an integral globally coordinated air navigation services system that will meet the growing requirements in air transportation and provide a number of benefits for all flight participants and service personnel.

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