Processing of Flight Information based on Approximation with Analytical Connections

Volodymyr Shutko[1], Lidiia Tereshchenko[1], Olena Kolganova[1], Viktoriia Volkogon[1], and Antonii Shutko[1]

[1]*National Aviation University, 1 Lubomyr Huzar ave., Kyiv, 03058, Ukraine*

Abstract

The conflict of airships is understood as their convergence in space and time, during which there is a violation of the specified minimum separation distance (echeloning). An increase in the intensity of flights inevitably leads to an increase in conflicts between airships. The minimum separation distance between aircraft is determined by their protective spatial zone with regulated geometry. Thanks to the proposed mathematical and software, it became possible to reduce the protective space zone and thereby reduce the minimum permissible interval between aircraft and increase flight safety, as well as to optimize the structure of airspace to improve throughput and thereby increase flight safety.

Keywords

Traffic safety, data processing, risks assessment, operation system, air navigation system.

1. Introduction

The relevance of maintaining traffic safety in the aeronautical environment is consistently high. It is caused by several processes accompanying the development of aviation technologies [1–4].

The intensity of air traffic is growing exponentially (5–6% per year). An increase in traffic leads to an increase in the frequency of delays. Air traffic safety is based on methods and algorithms for detecting and preventing conflict situations [5, 6]. For this purpose, there is a need to improve the existing air traffic control systems on the route and improve the algorithms of their functioning. Modern concepts are aimed at increasing the safety of flights, providing aircraft with the ability to fly within clearly defined airspace along arbitrary routes [7]. However, they do not fully satisfy the modern requirements of air traffic safety, as they do not ensure full autonomy of aircraft movement, and reliable resolution of conflict situations in the airspace is not performed [8, 9]. There is an acute problem in improving the algorithmic maintenance of the future aero-navigation system on a safe and effective basis [10 –13].

2. Statement of the Problem

The analysis of available sources of information shows that the existing concepts related to flight autonomy, such as Free Flight, A3, TCAS, S&A, ADS-B, and ASAS are imperfect. This is because systems of this level are multi-faceted complex systems with a hierarchical organization scheme, which contains technical, organizational, informational, management, socio-technical and energetic components. These concepts can solve only partial problems of air traffic safety. The results of recent research revealed certain existing shortcomings and limitations of these concepts in the implementation of autonomous flight [14–16].

Eurocontrol has formulated a strategy for the development of the air traffic organization for the coming decades. An important role is given to the development of new principles of air traffic management and airspace organization [17].

The technology of self-organizing systems is currently considered the only technology capable of offering adequate methods, architecture, and instrumental support for the software implementation of the most complex modern

CPITS 2023: Workshop on Cybersecurity Providing in Information and Telecommunication Systems, February 28, 2023, Kyiv, Ukraine
EMAIL: vnshutko@ukr.net (V. Shutko); 10118@ukr.net (L. Tereshchenko); kolganova@nau.edu.ua (O. Kolganova); sonechkovikaa@gmail.com (V. Volkogon); tohashutko5@gmail.com (A. Shutko)
ORCID: 0000-0002-9761-5583 (V. Shutko); 0000-0001-8183-9016 (L. Tereshchenko); 0000-0002-1301-9611 (O. Kolganova); 0000-0002-6813-5724 (V. Volkogon); 0000-0001-6174-2292 (A. Shutko)

systems. This technology has great prospects, first of all, about systems that are characterized by openness, large dimensions, the autonomy of its component subsystems and their network organization, as well as mobility [18].

It can be said that the process of self-organization of the system confirms that the effectiveness of rational and purposeful actions is weakening, the organization itself "creates" itself, sometimes opposing conscious leadership. Research into the processes of self-organization provides an opportunity not only to identify the mechanism of autonomous cyclical self-support but also to find an opportunity to start this mechanism [19, 20].

Let's consider a special case when two planes in the airspace have to pass each other at a safe distance. For this case, an analogy can be drawn with connected pendulums that can move freely at the same height. We impose a condition or "bind" two bodies not rigidly, but so that they cannot touch each other. At the same time, it is also not necessary that the bodies do not diverge over a long distance (that is, the plane remains on its route) [21].

The goal is to improve the mathematical and software of the automated aircraft traffic control system in terms of conflict prevention in autonomous flight conditions [22].

3. Materials and Methods

The task is to find mathematically two harmonics for the case when the lengths of the pendulums are the same. As an example of linear oscillators with nonlinear coupling, consider the equation

$$\ddot{x}_1 + \omega_1^2 x_1 = a x_1 x_2 \quad (1)$$

$$\ddot{x}_2 + \omega_2^2 x_2 = \beta x_1 x_2 \quad (2)$$

where the quadratic terms on the right-hand side describe the relationship.

Let the deviation of one pendulum be x, and the other—y, as shown in Fig. 1. In the absence of a spring, the gravitational force acting on the first pendulum is proportional to its deflection. If there were no spring here, then a certain natural frequency ω0 would appear for one pendulum, and the equation of motion, in this case, would take the form

$$m\frac{d^2}{dt^2} = -m\omega_0^2 x$$

The second pendulum, in the absence of spring, would swing exactly like the first. However, in the presence of a spring, in addition to the restoring force arising as a result of gravity, there is an additional force from the spring that tends to "pull" the pendulums. This force depends on the excess of deviation x over deviation y and is proportional to their difference, that is, it is equal to some constant, dependent only on the geometry, multiplied by (x-y). The same force, but in the opposite direction, acts on the second pendulum. Therefore, the equations of motion that we must solve will be as follows:

$$m\frac{d^2x}{dt^2} = -m\omega_0^2 x - k(x-y), \quad (3)$$

$$m\frac{d^2y}{dt^2} = -m\omega_0^2 y - k(x-x), \quad (4)$$

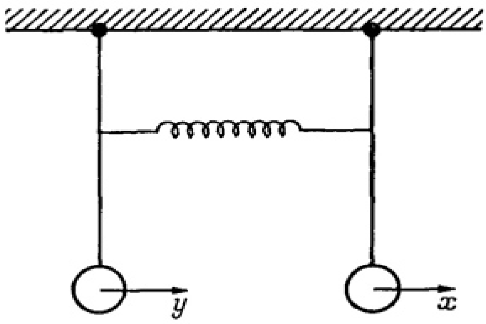


Figure 1: A model of connected pendulums

To find the motion at which both pendulums oscillate at the same frequency, we must determine how much each of them deviates. In other words, pendulum A and pendulum B will oscillate with the same frequency and with certain amplitudes of A and B, the ratio of which is fixed. Let's check how suitable this solution is:

x=Aeiωt y=Beiωt.

If we substitute it into equation (1) and add similar terms, we get

$$\left(\omega^2 - \omega_0^2 - \frac{k}{m}\right)A = -\frac{k}{m}B,$$
$$\left(\omega^2 - \omega_0^2 - \frac{k}{m}\right)B = -\frac{k}{m}A. \quad (5)$$

When deriving these equations, we reduced the common factor eiωt and divided everything by m. Now we see that we have two equations for what would seem to be two unknowns. However, in reality, there are no two unknowns here, because the general scales of motion cannot be found in these equations. They can only give us the ratio of A to B, and both equations must give the same value. The requirement that the equations be consistent with each other requires the frequency: it must be something very special.

But finding the frequency in this particular case is quite easy. If we multiply both equations, we get

$$\left(\omega^2 - \omega_0^2 - \frac{k}{m}\right)^2 AB = \left(\frac{k}{m}\right)^2 AB$$

On both sides, the product AB can be truncated, except when either A or B is zero, which means no motion at all. But if there is movement, then other coefficients must be equal to each other, which leads to a quadratic equation. As a result, two possible frequencies are obtained:

$$\omega_1^2 = \omega_0^2 \, \omega_1^2 = \omega_0^2 \ \text{i} \ \omega_2^2 = \omega_0^2 + \frac{2k}{m}.$$

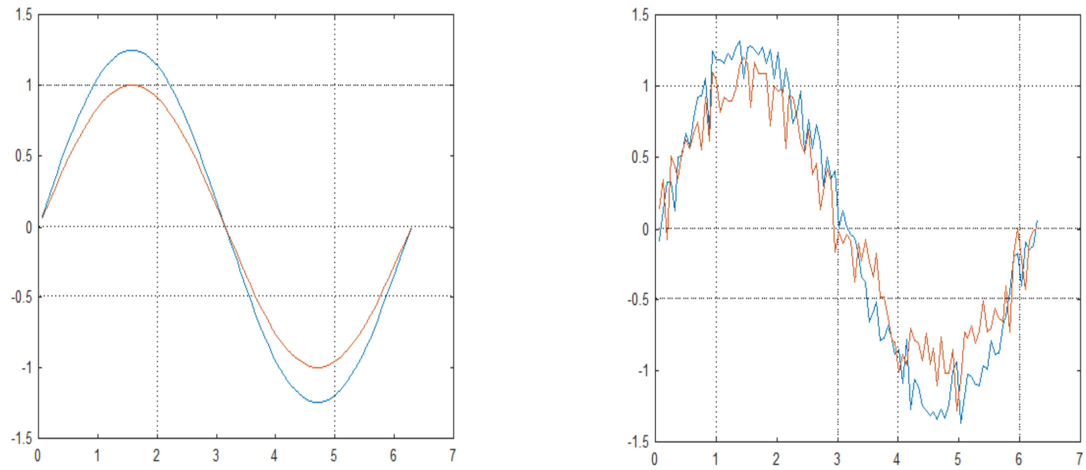
$$\omega_2^2 = \omega_0^2 + \frac{2k}{m}.$$

Moreover, if we substitute these values of frequencies again in equation (5), then for the first frequency we will get A = B, that is, the spring will not stretch at all and both pendulums oscillate with the frequency ω0, as if there was no spring at all. In another solution, when A = -B, the spring increases the restoring force, and the frequency increases.

This problem was solved in stochastics by referring to H. Haken (he is the founder of the synergistic approach in the deterministic formulation of the problem) [23], but we decided to take into account the stochasticity of the process.

4. Results and Discussion

As a result of modeling the movement of pendulums in the ideal case, in the absence of noise, interference, and other distortions, we have the following curves (Fig. 2a). But in real life, a system of connected moving objects is exposed to various types of disturbances. In addition, there are always errors in the measurements of the movement parameters of these objects. This is reflected in the curves (Fig. 2b).



a b

Figure 2: An example of stochastic oscillations of pendulums with different SLEs of noise: a) deterministic foundations; b) a real signal, which includes a deterministic basis and noises.

We will perform wavelet filtering of the amplitudes of stochastic pendulums taking into account the analytical relationships between their determined bases to increase the accuracy of data evaluation.

To filter the parameters of mathematical pendulums by classical and proposed (taking into account analytical connections between their deterministic bases) methods, we use a multi-scale analysis with a biorthogonal spline wavelet of the eighth order as a basis function.

Based on B-splines, several biorthogonal bases of bursts are constructed. For example, the scaling function and the Malla-Zong burst are defined in terms of their Fourier transforms as follows:

$$\bar{\varphi}(\omega) = \left(\frac{\frac{\sin\omega}{2}}{\frac{\omega}{2}}\right)^{2n+1}$$

$$\hat{\psi}(\omega) = \left(\frac{\frac{\sin\omega}{4}}{\frac{\omega}{4}}\right)^{2n+2}$$

The smoothing function φ φ (t) and the wavelet function ψ (t) are shown in Fig. 3.

Note that in the case of biorthogonal bursts, different filters must be used for forward and reverse transformation.

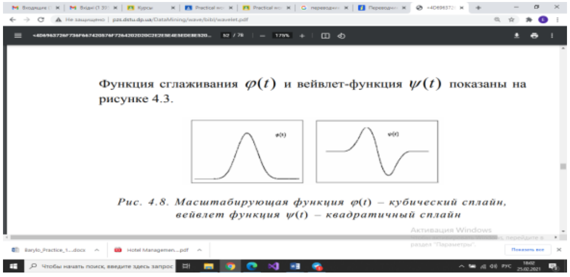


Figure 3: The scaling function φ φ (t) is a cubic spline, the wavelet function ψ (t) is a quadratic spline

The function for calculating the coefficients of wavelet filters for stochastic pendulums, taking into account the linear relationship between them, has the form:

$$\Phi = \sum_{k=1}^{N}\left[a_{1,-\frac{R}{2}} \times y_{1,k-\frac{R}{2}} + a_{1,-\frac{R}{2}+1} \times y_{1,k-\frac{R}{2}+1} + \ldots + a_{1,0} \times y_{1,k} + a_{1,1} \times y_{1,k+1} + \ldots + a_{1,\frac{R}{2}} \times y_{1,k+\frac{R}{2}} - y_{1,k}\right]^2 + +$$
$$+\omega_1^2 (a_{1,-\frac{R}{2}} \times y_{1,k-\frac{R}{2}} + a_{1,-\frac{R}{2}+1} \times y_{1,k-\frac{R}{2}+1} + \ldots + a_{1,0} \times y_{1,k} + a_{1,1} \times y_{1,k+1} + \ldots + a_{1,\frac{R}{2}} \times y_{1,k+\frac{R}{2}}) -$$
$$-\alpha(a_{2,-\frac{R}{2}} \times y_{2,k-\frac{R}{2}} + a_{2,-\frac{R}{2}+1} \times y_{2,k-\frac{R}{2}+1} + \ldots + a_{2,0} \times y_{2,k} + a_{2,1} \times y_{2,k+1} + \ldots + a_{2,\frac{R}{2}} \times y_{2,k+\frac{R}{2}})]^2 = \min$$

where a_{1i}, a_{2i}, a_{1i}, a_{2i}, is the coefficient of the low-frequency wavelet filter (Low); λ—is a weighting factor characterizing the rigidity of the analytical connection; y—input readings of the signal; ω_1^2 ω_1^2—oscillation frequency of the first pendulum; α—is the weight coefficient of the equation of motion of the first pendulum (4).

We will conduct statistical modeling and build a comparative table of filtering by the classic and proposed methods (Table 1). We can see that the accuracy advantage of the new method is many times higher than that of the classical method. The accuracy indicators of flight data measurement do not deteriorate, but on the contrary, improve.

To find the optimal coefficients, we will compile the following system of equations:

$$a_{1i}, a_{2i}, \quad \left(i = -\frac{R}{2}, -\frac{R}{2} + 1, \cdots, \frac{R}{2}\right)$$

$$\begin{cases} \dfrac{\partial\Phi}{\partial a_{1,-\frac{R}{2}}} = 0; \\ \dfrac{\partial\Phi}{\partial a_{1,-\frac{R}{2}+1}} = 0; \\ \vdots \\ \dfrac{\partial\Phi}{\partial a_{1,\frac{R}{2}}} = 0; \\ \dfrac{\partial\Phi}{\partial a_{2,-\frac{R}{2}}} = 0; \\ \dfrac{\partial\Phi}{\partial a_{2,-\frac{R}{2}+1}} = 0; \\ \vdots \\ \dfrac{\partial\Phi}{\partial a_{2,\frac{R}{2}}} = 0. \end{cases}$$

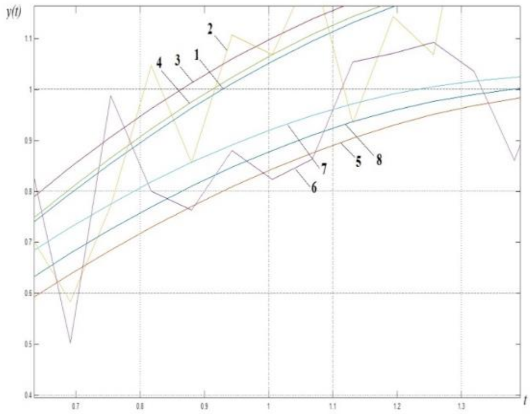


Figure 6: A fragment of the filter graph of analytically connected pendulums: 1 is the deterministic base of oscillation of the first pendulum; 2 is the mixture of the useful interference signal, which is observed at the input of the automated data processing system; 3 is the result of filtering by the classical method; 4 is the result of filtering by the proposed method; 5 is the determined basis of oscillation of the second pendulum; 6 is the mixture of the useful interference signal, which is observed at the input of the automated data processing system; 7 is the result of filtering by the classical method; 8 is the result of filtering by the proposed method

We will conduct statistical modeling and build a comparative table of filtering by the classic and proposed methods (Table 1). We can see that the accuracy advantage of the new method is many times higher than that of the classical method. The accuracy indicators of flight data measurement do not deteriorate, but on the contrary, improve.

Table 1
Root mean square deviation

Root mean square deviation of the useful signal mixture from the deterministic basis of oscillation of the first pendulum	Root mean square deviation of the filtered mixture from the deterministic basis of oscillation of the first pendulum (classical method)	Root mean square deviation of the filtered mixture from the deterministic basis of oscillation of the first pendulum (the proposed method)	The advantage is in the accuracy of the filtering of the first pendulum	Root mean square deviation of the useful signal mixture from the deterministic basis of oscillation of the second pendulum	Root mean square deviation of the filtered mixture from the deterministic basis of oscillation of the second pendulum (classical method)	Root mean square deviation of the filtered mixture from the deterministic basis of oscillation of the second pendulum (the proposed method)	The advantage is in the accuracy of filtering of the second pendulum
0,1	0,024	0,019	+26%	0,1	0,024	0,016	+50%
0,15	0,036	0,028	+28%	0,15	0,036	0,023	+56%
0,2	0,047	0,037	+27%	0,2	0,047	0,030	+56%
0,25	0,059	0,046	+28%	0,25	0,059	0,037	+59%

As evidenced by the data presented in Table 1, the advantage in filtering the accuracy of the first pendulum by the created method is 26–28 percent compared to the classical filtering method. At the same time, the accuracy of filtering the second pendulum by the developed method is 50–59 percent higher than the accuracy of the classical filtering method.

Let's graphically display the results of modeling the dependence of the Root mean square deviation deviation (RMS) of the filtered signal relative to its deterministic base on the mean square deviation deviation of the input noise (in the range from 0.1 to 0.25) for both pendulums (Fig. 7)

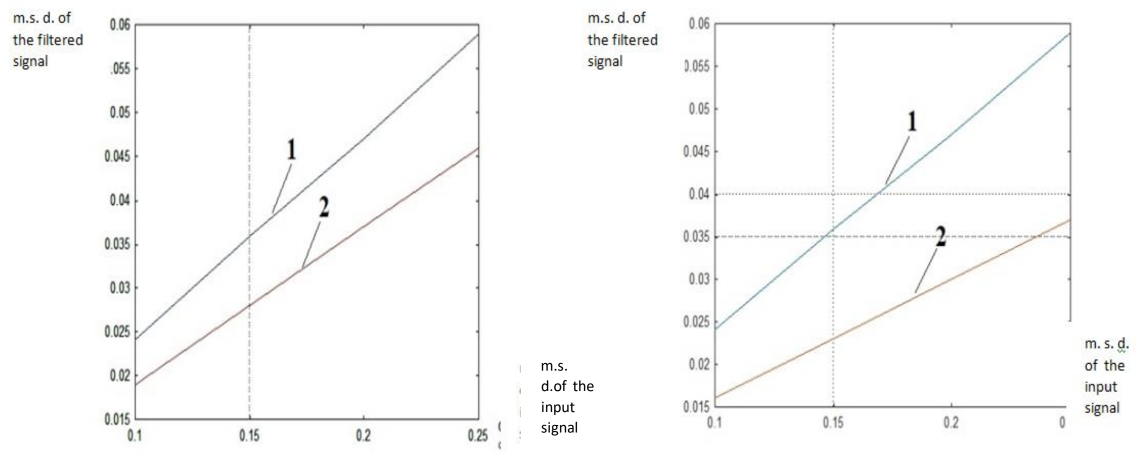


Figure 7: The results of the modeling in a graphical form

where: 1—the MSD of the filtered signal from the deterministic base of the pendulum oscillation, obtained by the classical filtering method; 2—MSD of the filtered signal from the deterministic basis of the pendulum oscillation, obtained by the proposed filtering method.

Analysis of graphs of functions in Fig. 7 shows that the proposed mathematical and software allows significant gain in reducing the SLE of the filtered signal. The first graphic window displays the results of the accuracy assessment of data filtering of the first pendulum, and the second graphic window shows the results of the second pendulum.

One of the design variations of conflict detection algorithms is the shape and size of the "protected zone". The protected zone is actually defined by the threshold values used in the conflict detection logic. That is, mathematical models of three-dimensional volumes, as a rule, are not supported in real-time implementations. Rather, airspace volumes serve as conceptually useful concepts for understanding the logic of conflict detection.

A "flattened spheroid" is a mathematically convenient shape for a protected zone. This volume is usually obtained by considering some vertical division as equivalent to some horizontal division [24].

For example, in cruise flight, a vertical deviation of 1,000 feet may be considered the equivalent of five miles of horizontal separation. Vertical units are simply scaled to the equivalent horizontal division.

This is mathematically convenient, since a single value can be calculated to characterize the separation between two aircraft. Fig. 9 illustrates a "flattened spheroid".

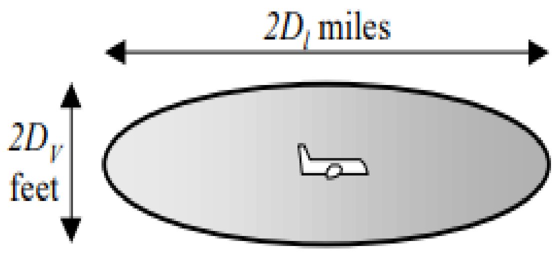


Figure 9: Protected spheroid zone

A "cylindrical" protected zone is another common shape used in conflict detection algorithms. For this protected zone, the separation criteria in both axes are checked separately. Fig. 10 illustrates the conceptual scope that results from this scheme. Five miles of zonal separation and 1000 feet of vertical separation are still appropriate examples of separation parameters. Although the braided spheroid is mathematically simpler, the cylindrical shielded zone has the advantage of being consistent with existing separation criteria used today. In addition, it is most likely a division of the airspace that corresponds more to the perception of the pilots.

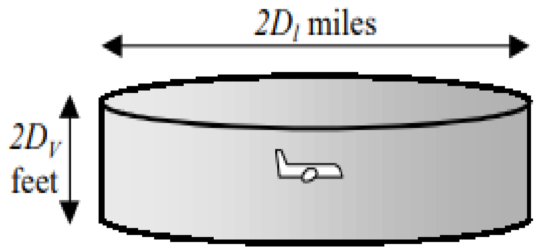


Figure 10: Cylindrical protected zone

The RTCA CD&R working group aims to simultaneously use two protected zones for each aircraft—the Protected Airspace Zone (PAZ) and the Near Mid-Air Collision (NMAC) zone. The PAZ would define the desired airspace separation standards. For example, a criterion of five miles per 1,000 feet would define a PAZ. The NMAC zone is intended for tighter closure of the aircraft. A smaller protected zone can be used to generate high-level notifications.

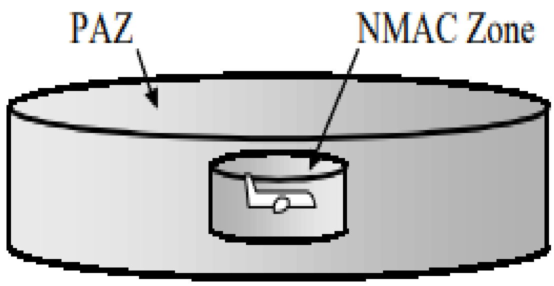


Figure 11: Protected Zone (PAZ) and Near Air Collision Zone (NMAC)

Thanks to the developed mathematical and software, it became possible to reduce the protective space zone (Fig. 11) and thereby reduce the minimum permissible interval between aircraft and increase flight safety.

The expected increase in air traffic density, a change in the dynamics of the relative movement of aircraft and a decrease in echeloning norms increases the probability of dangerous convergence of aircraft. Under these conditions, the role of systems for detecting and preventing potentially conflict situations is growing significantly.

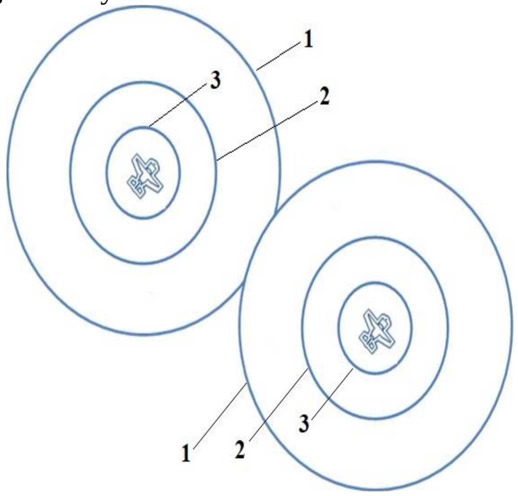


Figure 12: Protected Airspace Zone (PAZ—Protected Airspace Zone):

1—for stochastic formulation of the problem; 2—after classic filtering; 3—after the suggested filtering.

An important role is given to the development of new principles of air traffic management and airspace organization, which are designed to ensure high throughput of the route network and the ability to fly on the most efficient trajectories with a guaranteed level of safety.

The aircraft monitors the current flight path of the aircraft from the point of view of possible conflicts. (In practice, the automatic ASAS function will monitor all relevant traffic and alert the flight crew of any conflicts. The bottom line is that the flight crew is responsible for separation from all aircraft, so the aircraft, not the ground systems or the controller must detect conflicts.) The aircraft entity adjusts its flight path as necessary to resolve any conflict, avoiding loss of separation with any other aircraft as a result of a change in trajectory.

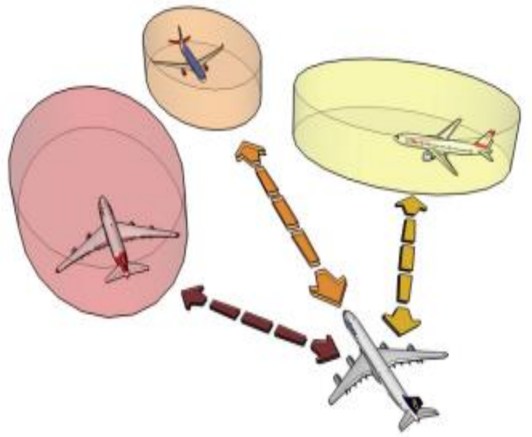


Figure 13: Conflict management

The aircraft entity adjusts its trajectory as necessary or as desired, having determined that the new trajectory is conflict-free within some acceptable time horizon.

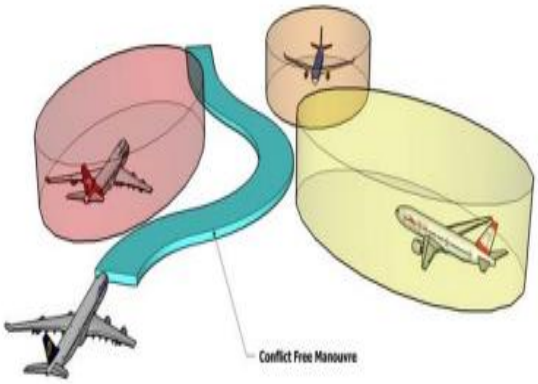


Figure 14: Maneuver without conflict

5. Conclusions

An increase in the intensity of flights inevitably leads to an increase in conflicts between airships. A conflict of airships means such a convergence of them in space and time, during which there is a violation of the specified minimums of separation distance (echeloning). The minimum separation distance between aircraft is determined by their protective spatial zone with regulated geometry.

The possibility of using already existing methods of processing results, as well as the characteristic features of the behavior of wavelet transformation in the time-frequency domain allow to significantly expand and supplement the capabilities of such systems. It can be concluded that the wavelet transformation taking into account analytical connections provides a more accurate and informative picture of the results of simulation and experiment. Allows you to better clean the input data of the movement of the aircraft from noise and random distortions.

Thanks to the proposed mathematical and software, it became possible to reduce the protective space zone and thereby reduce the minimum permissible interval between aircraft and increase flight safety, as well as to optimize the structure of airspace in order to improve throughput and thereby increase flight safety.

6. References

[1] V. Chepizhenko, V. Volkohon, FAA Announces Automatic Dependent Surveillance-Broadcast Architecture (Press release), FAA Office of Public Affairs. July 1 - 2002. APA 27-02. Retrieved2011-02-21. doi:10.15421/431511

[2] V. Shutko, et al., Application of Spline-Fourier Transform for Radar Signal Processing, IEEE 15th International Conference on the Experience of Designing and Application of CAD Systems (CADSM), Polyana, Ukraine, 2019, 1–4. doi:10.1109/CADSM.2019.8779279

[3] M. Zaliskyi, et al., Shadow Image Processing of X-Ray Screening System for Aviation Security, Int. J. Image Grs. Signal Process. 14(6) (2022) 26–46. doi:10.5815/ijigsp.2022.06.03

[4] M. Kuhn, K. Johnson, Applied Predictive Modeling, Springer, New York, 2013.

[5] I. Ostroumov, K. Marais, N. Kuzmenko, Aircraft Positioning Using Multiple Distance Measurements and Spline Prediction, Aviation, 26(1) (2022) 1–10. doi:10.3846/aviation.2022.16589

[6] I. Ostroumov, N. Kuzmenko, Statistical Analysis and Flight Route Extraction from Automatic Dependent Surveillance-Broadcast Data, Integrated Communications Navigation and Surveillance Conference, Dulles, USA, 2022, 1–9. doi: 10.1109/ICNS54818.2022.9771515

[7] O. Solomentsev, M. Zaliskyi, O. Zuiev, Radioelectronic Equipment Availability Factor Models, Signal Processing Symposium (SPS), Serock, Poland, 2013, 1–3. doi:10.1109/SPS.2013.6623616

[8] J. Al-Azzeh, et al., A Method of Accuracy Increment Using Segmented Regression, Algorithms 15(10):378 (2022) 1–24. doi:10.3390/a15100378

[9] Z. Hu, et al., Statistical Techniques for Detecting Cyberattacks on Computer Networks Based on an Analysis of Abnormal Traffic Behavior, Int. J. Comput. Network Inf. Secur. 12(6) (2020) 1–13. doi:10.5815/ijcnis.2020.06.01

[10] Z. Brzhevska, et al., Analysis of the Process of Information Transfer from the Source-to-User in Terms of Information Impact, in: Cybersecurity Providing in Information and Telecommunication Systems II, vol. 3188 (2021) 257–264.

[11] F. Kipchuk, et al., Assessing Approaches of IT Infrastructure Audit, in: IEEE 8th International Conference on Problems of Infocommunications, Science and Technology (2021). doi: 10.1109/picst54195.2021.9772181

[12] V. Buriachok, V. Sokolov, P. Skladannyi, Security Rating Metrics for Distributed Wireless Systems, in: Workshop of the 8th International Conference on "Mathematics. Information Technologies. Education:" Modern Machine Learning Technologies and Data Science, vol. 2386 (2019) 222–233.

[13] M. Dyvak, et al., Mathematical Modeling of the Estimation Process of Functioning Efficiency Level of Information Web-Resources, 10th International Conference on Advanced Computer Information Technologies, 2020, 492–496. doi:10.1109/ACIT49673.2020.9208846.

[14] L. Ji, Y. Mou, Research on the Feasibility of Application of Millimeter-wave Security Screening Equipment in Civil Aviation, 2021 IEEE 3rd International Conference on Civil Aviation Safety and Information Technology, 2021, 71–75, doi: 10.1109/ICCASIT53235.2021.9633747

[15] O. Semenov, Aviation Security Equipment, Kyiv: NAU, 2013.

[16] D. Anderson, Optimising Multi-layered Security Screening, J. Transp. Secur. 14 (2021) 249–273. doi:10.1007/s12198-021-00237-3

[17] K. Leone, Security System Throughput Modeling, 36th Annual 2002 International Carnahan Conference on Security Technology, 2002, 144–150. doi: 10.1109/CCST.2002.1049240

[18] S. Almazroui, W. Wang, G. Zhang, Imaging Technologies in Aviation Security,

European J. Appl. Sci. 3(4) (2015) 12–27. doi:10.14738/aivp.34.1433
[19] J. Skorupski P. Uchroński, A Human Being as a Part of the Security Control System at the Airport, Procedia Eng. 134 (2016) 291–300. doi:10.1016/j.proeng.2016.01.010
[20] O. Solomentsev, et al., Data Processing Method for Deterioration Detection during Radio Equipment Operation, 2019 IEEE Microwave Theory and Techniques in Wireless Communications, 2019, 1–4, doi:10.1109/MTTW.2019.8897232
[21] V. Cutler, S. Paddock, Use of Threat Image Projection (TIP) to Enhance Security Performance, 43rd Annual 2009 International Carnahan Conference on Security Technology, 2009, 46–51. doi: 10.1109/CCST.2009.5335565
[22] O. Shcherbyna et al., Diagnostic Process Efficiency Analysis for Block Diagram of Electric Field Parameters Meter, IEEE XII International Conference on Electronics and Information Technologies, 2021, 5–9. doi:10.1109/ELIT53502.2021.9501136
[23] M. Eby, W. Kelly, Free Flight Separation Assurance Using Distributed Algorithms, IEEE Aerospace Conference, Snowmass, CO, March 1999.
[24] M. Shutko, et al., Two-Dimensional Spectral Detector for Baggage Inspection X-Ray System, CEUR Workshop Proceedings, 2300 (2018) 63–66.