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ENHANCING SAFETY IN GLIDER FLIGHTS

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Abstract

The theme of paper is to find out new possibilities in safety improvements during sailplanes flights, focusing primarily on flights when the separation with other traffic is reduced. At the beginning a summary of glider evolution across the centuries is made starting with the interwar period to the shapes that we know from the latest exhibitions. First part of the paper is followed by the analysis of the current available technical measurements which enhance safety and reduce the probability of in-flight collisions during various phases of flight, including latest and most modern technical implementations used by glider operators to enhance the safety of themselves and others. We will also look up for any available legislative rules based both on national civil authority regulations defined by state itself and for regulations that were created by Fédération Aéronautique Internationale (FAI) which covers most of glider competitions organized world-wide. In practical part we followed our thoughts about how to improve the current situation in this part of the aviation industry. In following steps, we decided to ask the glider pilots about their personal experience with reduced separation caused by nearby gliders during different phases of operations. Generally, there is a huge number of mid-air collisions during sailplane competitions and flight phases where pilots are crossing each other by minimal separation (mountain ridge flying). We decided to suggest minor legislative regulations and technical implementations to improve current situation world-wide and make these flights as safe as possible with minimizing of future incidents.

Keywords

glider, safety measures, glider competition, visibility enhancement, anti-collision, technical implementations

1. INTRODUCTION

Glider flying is nowadays a hobby, sport, and a way to become a professional pilot. It is popular and due to the favourable price of the training it attracts many young people, for whom it is often the only way to get closer to real flying and how to get involved in aviation associations, flying schools and aeroclubs.

In their beginnings, gliders were mainly used in the military environment to fulfil various types of tasks, but the new era brought significant progress in this industry as well, and today we perceive these machines on many levels, from simple gliders designed for aviation training needs to high-performance versions able to fly long distances at a relatively high average speed.

This flying sport is one of the most demanding. The pilot is burdened in many aspects and there are often situations where in addition to perfect flying technique pilot needs to use his capacity in the decision-making processes and tactics of the flight itself. Nowadays, we already know powerful navigation systems and flight monitoring systems that facilitate the work of pilots and offer the necessary overview of navigation, speeds or flight other flight information. However, even this does not prevent the relatively high annual occurrence of collisions with other traffic, especially during competition flights, when there are many gliders in one updraft or on the ridge.

The aim is to focus on the high number of collisions between two or more airplanes in different phases of flight, either during the competition flights or during other types of operations across aeroclubs. Glider pilots are often forced to come into proximity to other traffic.

The development of hardware and software components of non-motorized airplanes as well as the modifications of the rules for performing competitive flights may bring a significant shift in the future when any reduction in fatal collisions of airplanes would mean a leap in increasing the safety of glider flights.

2. HISTORY

The history of glider flying and this machines goes back a long way. Records of the first engineless airplane, which was able to take off with a person on board date back to 1853 when the British engineer Sir George Cayley firstly tested his new invention [1].

Figure 1 - One of the first gliders

The first built non-motorized aircraft like today's machines was the Waco CG-4A designed for the needs of the US Army. It was constructed of iron and wood, while the surface consisted of a stretched canvas, which was regularly inspected for safety.

Initially, the gliders were mainly used to carry out "quiet" military operations. They were deployed to move forces as close as possible to their destination so that soldiers could attack the enemy unobserved and without drawing unnecessary attention to themselves.

To perform their required activity, it was not necessary for the gliders to achieve breakthrough performance and have excellent glide.

These were machines weighing more than two tons, and JU-52 or Douglas C-47 type machines used to be used as towing aircraft, which had sufficient engine power to pull these gliders above the place from they were launched [2].

Figure 2 - Waco CG-4A

3. HIGH-PERFORMANCE GLIDERS

The evolution of the development of gliders has brought significant improvements in their aerodynamic properties, gradually improving the final performances such as glide ratio, sink rate and many others. The signature of the new era brought a significant difference in the used wing profiles for the given development period.

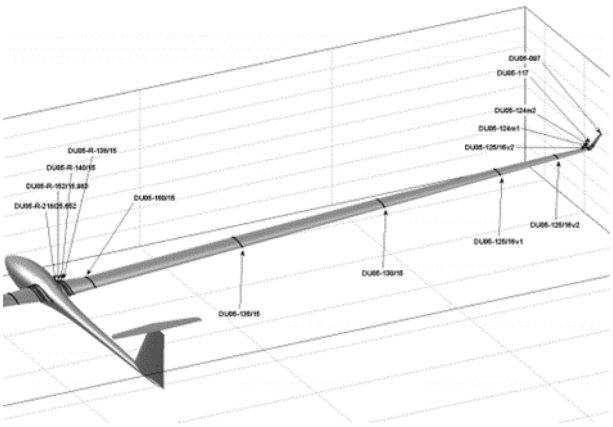

Figure 3 - Modern airfoils

Based on the characteristics of the operation of the given airplane, its designer can select the required type of wing profile. In general, we can divide profiles according to a whole range of criteria (bends of the middle curve, relative thickness, position of maximum thickness).

The development of engineless airplanes also saw progress in the field of materials used. While in the beginning, mostly wooden and later laminate structures were used, today it is durable but fragile composite materials that hold the lead in the production of powerful sports gliders.

Figure 4 - Ventus 3 by

It is characteristic for this era that products from Schempp-Hirth design workshops or other well-known manufacturers are very similar in terms of performance and so to speak, breaking away from the competition is a nearly impossible achievement. Nowadays the construction of a new model of a glider is a huge business risk, and that is why manufacturers pay attention to attributes such as comfort and safety. Interesting question is that what else can we expect from manufacturers in the future [3].

4. SAILPLANE COMPETITIONS

4.1. General rules

A sailplane competition organized under Fédération Aéronautique Internationale (FAI) typically lasts five to ten days with tasks set each day the weather is suitable.

Each contest features flights from the home airport, around turn points, and back to the home field. In poor weather, the course might be as little as 100 kilometres; in excellent weather it could be 500 kilometres or more.

Figure 5 - Fédération Aéronautique Internationale logo

Competitive soaring is all about speed. Fastest pilot around the course is receiving the most points for the competition day. The contest winner is the pilot with the most points at the end of the event. Seconds count and on some days may make the difference between winning and losing. Regional competitions

are held across the country, in Slovakia usually in Prievidza, Nitra or Partizánske, typically lasting up to 14 days and usually include 60 to 100 competitors. A handful of pilots from the national level are selected to compete internationally at the World Soaring Championships organized all around the world. The FAI maintains the rules by which competitions are conducted [4].

4.2. Flying on Course or How to Go Fast—and Far

Once a competition pilot starts the task, the race is on. While the difference between winning and losing can be only seconds. Competition pilots must find the best rising air (thermals) to gain the altitude needed to complete the course. The higher you go, the farther you can go. Thermals are often capped by a fluffy cumulus cloud making the lift. The skill of finding and using these invisible columns of rising air is what makes competitive soaring challenging. Competitors find thermals using their experience and then keep the sailplane in the narrow column of raising air by circling tightly and monitoring their senses and instruments [4].

To be successful, competitors must balance competing forces. Competitors are constantly making many critical decisions on course that will affect their overall performance.

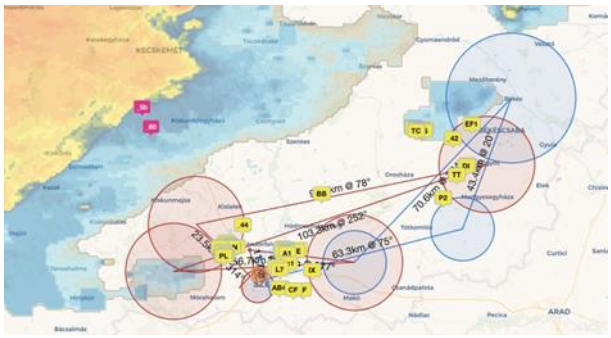

Figure 6 - Racing task

4.3. Finish

Just as every race needs a start, it needs a finish as well. As competitors near the home airfield, they start what is called final glide when they think they have enough altitude to arrive at the field with just enough energy to fly across the finish line and land. Final glides can be started many kilometres away from home airfield. Landing sailplanes are going fast and very low as they cross the finish. Often many gliders arrive at the same time at the finish [4].

5. LEGISLATION AND RULES

5.1. EASA and National requrements

According to EASA CS-22 document, gliders approved for VFR DAY flights are not required to be fitted by any of external light. This requirement is taken over also by the Slovak national legislation. Only requirement associated with external lighting is that if there are any of them installed on the aircraft, they need to be approved by authority [5].

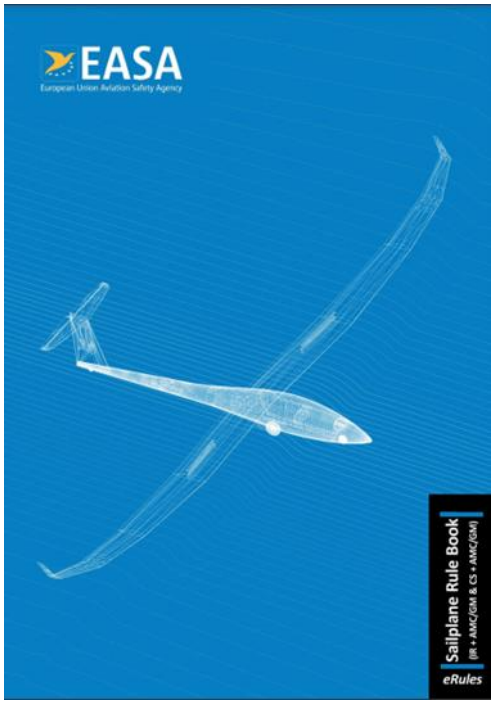

Figure 7 - EASA CS-22

5.2. FAI requirements and competition rules

If there is a talk about the safety in sailplane competitions, we have to look at document called Annex A to Section 3 – Gliding which was published by Fédération Aéronautique Internationale (FAI). All glider competitions organised under FAI shall accept their terms according to this document. At the other hand organiser should have final decision for any other safety precautions like hi-visibility markings or any lightning system of the aircraft.

Judging by competition rules published on roughly all competitions in our country there is requirement to have operating FLARM anti-collision system on board, updated and functioning. This rule is verry often checked by our national authority officers on the starting grid before starting the task. Although after many years there is some first mention about lightning system of the sailplane aircraft and soon sailplanes competing on the highest levels will be technically required to have operating strobe light on board [6].

6. CURRENT STATE

In this section we will discuss the current situation of safety in glider flights in our country and internationally. We would like to introduce you into procedures and safety precautions used by pilots in real.

If we are talking about anti-collision systems used nowadays, we have some options to mention, that they are common and almost used by all the pilots not only in glider competitions, but generally across the aeroclubs and flying schools. At the other hand there are some precautionary systems which are still new-born it will take some time for them to be implemented to the real operation.

6.1. FLARM

FLARM (an acronym based on 'flight alarm') is the name for an electronic device which is in use as a means of alerting pilots of small aircraft, gliders, to potential collisions with other aircraft. Important is that the aircraft should be both similar equipped, so the system is fully working.

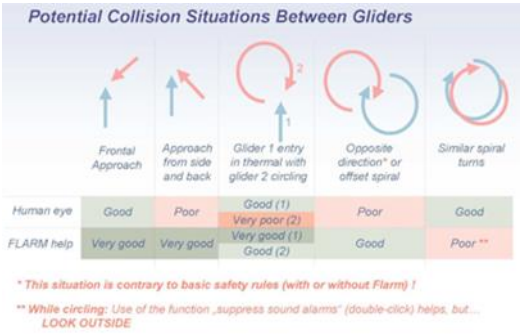

Figure 8 - FLARM vs Human eye difference

FLARM obtains its own aircraft position from an internal Global Positioning System (GPS) unit and a barometric sensor, and this is updated every second. The data is then broadcast by a low power RF transmitter (868.2 MHz) along with a 30 second projection of a likely 3D flight path. Its receiver searches for other FLARM devices within range and processes the information received.

Data on potential conflicts with up to 50 other participating aircraft are stored and aural and visual alerting is used to warn the pilot.

Figure 9 - FLARM display

The FLARM Unit will provide an alert in respect of the greatest current danger by means of a 'buzzer' or 'beep') and illumination of a Light Emitting Diode (LED) indicator. The display will show the threat level and the lateral and vertical bearing of this threat. If a suitable database is installed, FLARM can also warn of the presence of static aerial obstacles such as masts and cables (database must be obtained).

Figure 10 - FLARM during the flight

FLARM system is commonly used across the gliding world and in required on almost all gliding competitions across the world as its defined as requirement of FAI Annex A document.

Advantage of this system is that it's low consuming and saves glider battery as we all know that glider is not equipped with any source of generating electrical power [7].

7. FLASHING SYSTEMS- STROBE LIGHTS

Strobe lights systems mounted on the gliders are still rarely used by pilots. One of this system has been developed by Sotecc company.

Canopy mounted LED flashing system already mounted on more than 2500 sailplanes all around the world brings ideal combination of glider visibility in many situations.

Figure 11 - SOTECC strobe

From the real practice we all know that almost none of the sailplane is fitted by external lightning system. Neither position nor any strobe lights are used [8].

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