THERMALS MAP – ASSIST FLIGHT SYSTEM

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***Abstract**: The article presents proposition of the assist pilot system. The system helps pilot with correct decision of cross country flights. Presentation of specially calculated information stored by the system delivered to pilot could help him with his decision about correct directions of crossing.*

***Keywords**: Knowlage base, Data mining*

***ACM Classification Keywords**: E. Data, E.5 Files, E.5.6. Sorting/searching*

Introduction

Dream about flying has been following in most of people through the years. Some people make this dream came true. By those dreams, people all the time have been trying to get to the clouds. The ways of their trip were different. Human constructed a glider, plane, rocket and other flying machines as answer of this needs. But in every cases life showed them that flying is not as easy as it looks like. Birds and they behaviors, that people follow all the time, are still the question. How they do that ?

When people get to the air they tray to stay there as long as they can. Sometimes it was easy, sometimes not but all the time people ask how to get to the sky faster and stay there higher and longer. The observations and all of experiments became a science. The flying has been a topic of thesis and experiments. Lots of later theories, analysis and practices were based on bird's behaviors. At the end of all of experiments people discovered instruments which helped them with conquest their nature. But no matter how the instruments ware perfect flaying was always a big mystery. This mystery was a fuel for development of flying science.

Flying, in his pure form like soaring and thermal flying is a good place for many experiments and thesis. These drive to working out solutions which make flaying easy. These solutions help pilots make a final decision during their flights. Decisions are different. Sometimes they realize on carrying about temporary direction, height of the flight or choosing the landing place. But sometimes they are more complicated and depend on many things. That's decisions are usually critical aspects of flying, specially when the security is considered.

Flying on different kinds of gliders is what we call as a free flying. That means that the pilot doesn't need anything but pure nature forces like thermal or soaring wind. Many things which help pilot with his trip are necessary, specially when the flight is cross county type.

The main topic of this article is finding the system which helps to choose the right direction of the flight. This paper focuses on paragliders. With comparison to classic glide and delta-glide this constructions have a number of limits like: fly speed and glide ratio. Because of this limits paraglider pilot's decisions are always based on large knowledge about flying in different conditions. The way of crossing area where the fly is made is an individual tactic of flight. In many cases pilot sees the area of flying for the first time, so his knowledge about tactic is poor. His flights are usually not as long as they are supposed to be. The question is: how to get the special tactic knowledge for pilot ? How to decide which direction is correct ? These and many other questions connected with the flight have no answers.

This problem seems to have no solution but some of specially calculated information delivered to pilot could help him with his decision about correct directions of crossing. All cross country pilots after taking-off plan their trip. In many cases the plan is based on studying the log files of other pilot's flights. The files are stored in Internet site of XCC system where pilots report they flights in. It is a good source for any study in this topic. Files have the same format made in world standard named igc. Internet source of log files is public available.

Knowledge base

Mentioned XCC (http://xcc.paragliding.pl/) is not the only place of gathering data about paragliding flights. In the Internet there are many other similar web pages like XContest (http://www.xcontest.org/world/en/) or local data bases. They also use mentioned files format (igc). The greatest advantage of IGC format is its universality and that it is used by every XC pilot worldwide, which is a big help in flights analysis.

...
B1405365448657N01822350EA0000000043
...
where:

B140536 - utc Time 14h 05m 36s (T)

GPS position:
5448657N - 54-48.657 N (X)
01822350E - 018-22.350E(Y)

Height
A
00000 – height by barometer
00043 – height by GPS (Z)

Figure 1. Flies format igc [Davies, 1995]

IGC is type of text file. Thanks to quality of files gathered information are easier to analyze. There are no additional interfaces that usually cause problems in data reading. Data record igc is not complicated. It consists records, which are sequence of pilot's position in four dimension space (T,X,Y,Z) (Fig.1). Such accuracy allows fix route of flight. It also enables to check if there was a record of descending or ascending in the area where pilot was flying.

This information is essential in data analysis in topic of this article. Obtained geographic coordinates allow us to place and estimate behavior of flying object in space. Analysis of greater amount of data on set penetrated area give configuration of track points from particular flights in effect. This points can be taken as a compilation, which will be used to form areas being potential zone of ascend of zones thermal inactive. Mentioned groups of points can be presented in time and thus we can have changeable configuration of registered ascends. Time of record of geographic point makes these zones more dynamic.

Project will use files saved during flights in mountains. This area lets to cut down number of factors that influence the flight. Mountains and valleys determine wind direction and in some level limit variables like for instance ground contrast connected with character of grown plants which have influence on generating lifts as well as many other important weather conditions [Burkhard, 2007]. This thesis are concentrated on visualization of thermal active points as a "ascend map", not on analysis of arising those places and points in GPS tracks.

Analysis of data from tracklogs proposed in this article is a stage of initial recognition of prognosis possibilities and support navigation activities. In descriptions there were used only the most basic parameters. Many environmental factors that can have influence on flight were not taken into consideration. Full analysis of data is not possible due to too many mentioned variables and their impossible to predict character.

Characteristics of ascend map

Data in IGC files are often recorded in set time interval. Recording device to each point of GPS coordinates applies time value and saves it in standard UTC format. This is first value, starts next point in IGC file.

Time factor is used to display thermal active points on ascend map and record them in set moment of flight, thus to show the pilot probability of finding lifts in certain point and time. GPS coordinates enable for special orientation within first recorded point that starts the lift. Further points, where pilot stays in lift, have minor meaning due to the fact that thermal is being drifted by wind and its drift depends on wind direction. Different weather factors and pilots individual preferences of circling in thermal are also important. Therefore registration of all „lift points within thermal" can darken the map and not bringing any benefits in creating the map. GPS coordinates show position of finding a lift in horizontal setup with additional value – height. Horizontal setup places point of first contact with lift. This is position registered, what means that certain point will not be the point of triggering the thermal but only point of finding a lift by pilot. Registering height value during flight will show in three dimensional space pilot found a lift. When many tracks near to this point will be analyzed this will enable to visualize air activity in this area. The more tracks the easier to find places where it is the most probable to find a lift. Using time value helps us to show thermal activity of area while creating ascends maps. Using time also benefits in possibility of showing map not only in hours scale but also days, weeks, years scale. It makes easier to create statistics and detailed analysis of reasons for arising of "hot" – thermal active and inactive – "cold" places.

Technical details of ascend map

Creating ascend map process consists of a few stages. First stage is gathering data for marking interesting points. Choosing process based on data contained in IGC files. These data have to be initially processed by picking only lift zones from whole tracks. Chose method is classic comparison of forward recorded heights and picking first meaningful point which started the lift. Points selection is realized by differential method by comprising next track points.

During flight pilot can notice short turbulences connected with air instability and activity of thermals. These air movements are usually short and natural [Burkhard, 2007],[Suchan, 2001]. They are meaningless for gaining height, therefore they will be put aside.

Due to the fact that turbulences are making distraction and only blur the map is proposed not to take them into account. Therefore choosing of points, as previously, will be made by differential method, however point of first lift will be marked as first – beginning set time in which progressive values of lift, are being registered. If value of lift remains forward, points are showing growing value of height and points are being registered in 15 seconds interval. Fixed lift and starting point has being chosen as a start of lift. If within 15 seconds lift disappears registered starting point is treated as start of turbulence and it won't be taken into consideration when making the map.

After track analysis chosen thermal active points are compilation of several meaningful ingredients added to database. This base gathers all points as overall repertory for “ascends map”. The base holds main table containing active places coordinates and height as well as tables with additional supplementary data and selection of correct interesting points. These is information about start place, route etc. Number of additional data can be modified depending on needs. It doesn’t affect on „ascend map” directly but only makes data presentation more interesting.

Presentation of map

Presentation of points on map can be shown with very popular Internet instrument - Google Earth. Selected group of points has to be processed to KMZ format. This is Google Earth standard. Created this way group of points give us static picture that show places recorded in database as thermal active points. It is example of web interface being general view to analyze before flight. Target interface for “ascend map” is the one that is dynamic application working on gathered data. The idea of this system is to direct pilot on closest lift zone based on his actual position. In basic form interface will generate digitally flight parameters to get to thermal active point in “ascend map”. These parameters are: coordinates of lift from “ascend map”, its height and distance to lift. Parameters will show to the pilot exact point where lift had been recorded in the map. System’s role is to be a flight assistant, pilot can not depend on it absolutely and final decision should bee made based on pilots experience. He chose flight path based on actual weather conditions. System only gives a hint where are places thermal active with high probability of finding a lift.

Conclusion

In thesis it was presented proposition of using database with flights on example of application being flight assistant. This application would be additional tool helping young pilots to choose right route during cross country flights. In the article there was suggested data converting process for ascend map and two examples for data presentation

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