DSX systems

The T-Advisor module

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T-Advisor and Traffic Early Warning Systems

The T-ADVISOR is one of the modules of the DSX system and is an electronic equipment that notifies the pilot of the presence of other planes nearby.
The T-Advisor has been totally developed from scratch, with the only constrain of being able to detect the Flarm ® [1] systems and to be detected by them correctly. Everything, from the electronic board till the software that runs on it, has been designed by DSX.
The functioning idea of the T-Advisor is not the one of an Anticollision or Collision Avoidance System, rather the one of the Traffic Advisor, an Early Warning System. The difference meant here between the two solutions resides in the information they give to the pilot: an Anticollision System tries to determine and categorize the threats to the plane by the trajectories of other planes, performing a selection, possibly indicating to the pilot which action to take. Planes with trajectories that are considered, according to the internal calculations of the system, not to be dangerous, are not notified to the pilot like being potentially a problem. In this view, the electronic system decides what is dangerous and what is not, and consequently notifies the pilot. It's clear the paramount importance of having the assurance that the calculations on which to base the system decisions must be checked by expert organisms.
The Traffic Advisor, instead, notifies the pilot the presence of all planes that enter within the radio operating range (that for the T-Advisor is up to 7 km, almost three times the one of other existing systems for gliders). The philosophy behind the Traffic Advisor is that of empowering the pilot and not taking decisions on his behalf.

The development of the DSX T-Advisor

The only constrain in the development of the T-Advisor was the ability to detect and to be properly detected by the Flarm ® systems.
Actually, the real aeronautical systems aimed at safety are based on open protocols and follow a way of working that has been checked in advance to be safe and grant the performance required.

The Flarm system, that nowadays is used on many gliders, should have gone through test by professionals of the aeronautical industry, and should work according to a recognized standard. Moreover it should be an open system. Nevertheless, having to develop a module for the DSX system, firstly aimed at glider pilots, it wouldn't have made much sense to start another traffic detection standard: the world has to follow the road to a unified interaction rather than the one to a myriad of small universes. That is why the T-Advisor has followed this path, although it's not reputed to be the ideal one.

Since the project started like for a system for personal use of the designers, no concessions were made to cheap components and solutions: all parts were chosen from the top level quality and performance stand point of view. When it was decided to make it a part of the DSX system for customers, the components chosen remained.
The only part that is in common with the Flarm ® system is the chip for the radio transmission, that had to be chosen the same for obvious reasons.
The GPS sensor in the T-Advisor unit is the Trimble Copernicus: a chip that has been released to market in December 2006, hence its really new, with top performance. Compared to the GPS adopted by Flarm ®, the Copernicus has a vertical precision that is more than two times higher.

[1] All trademarks are registered by their owners

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This great performance has a direct effect for the distance and velocity calculation with respect to the other planes.
This different performance is clearly visible since many pilots use the data deriving from the traffic advisor systems for feeding sailplane navigation programs running on PDA's: the greater precision of the Copernicus can be immediately spotted from the fact that the vertical speed, Vz, is extremely stable and accurate. A test conducted with a T-Advisor and a Flarm ® standing in the same location and in the same exact conditions, showed that the gliding programs running on two PDA's connected to the instruments, displayed a great difference in Vz: the indication deriving from the T-Advisor was oscillating between -0.4 and +0.4 m/s, against values of -1.5 and +1.5 m/s.
In view of the IGC certification as Flight Recorder, the pressure sensor chosen is of top quality: the Intersema. With this component, and thanks to the filtering of the data programmed by DSX, the T-Advisor is capable of correctly distinguishing a difference in altitude when it is raised by a hand and then put on the floor.
Since the function of this DSX module is that of a Traffic Advisor, it must be able to trace, at each every instant, multiple targets. To do this, a powerful microprocessor is required and that is why the T-Advisor has a 16 bits computing unit that runs at 25 MHz. This processor is more powerful than the microprocessors that were used until some years ago in the personal computers.
The T-Advisor is capable of tracking at least up to 50 planes at the same time, using all their data of geographical coordinates, altitude, ground speed, true track, vertical speed, type of aircraft and identifying each of them with its own call sign and competition sign.

Why not an Anticollision system ?

Anticollision Systems are meant here as those that try to predict the future trajectory of the planes to calculate the possibility of their interference.
The calculation of the future trajectory of a glider, and at some degree of a the sport plane, is something that can become highly unreliable, considering that the glider pilot decides where to turn in the exact moment when he feels a thermal, or an ascendance or descendence. The trajectory prediction works very well for commercial planes and all those planes that fly along predefined routes and follow strictly regulated procedures. This is seldom the case of gliders and sport planes.
For the reasons above, a prediction of the trajectory of a glider at times 10 or 20 seconds after the present one, can be too often unreliable. Considering that the warning for dangerous planes is given based on the predicted trajectory, it's clear that a reliable system has to use another philosophy. It's enough that only once the system ignores a plane because its predicted trajectory is different from the real one, and the consequences can be terrible.

The philosophy of the T-Advisor

For the reasons explained above, the T-Advisor has been conceived following the philosophy of the traffic detector / advisor: notification to the pilot of the presence of other planes, with a reminder after certain time. The basic belief is that the pilot is the person in command and he has to bear in mind where the others are around him. The systems helps the pilot in doing so, but must never replace him. In fact, thanks to the continuous tracking of all planes in range, the T-Advisor checks constantly the approaching speed and the distance of each aircraft from the own plane, calculating continuously the possible time to impact. There is no question that a plane with a short time to impact has to be notified to the pilot, and so the T-Advisor does, helping the pilot in spotting a possible cause of danger.
The difference in the philosophy of operation of the T-Advisor from an Anticollision System is of paramount importance, because it assumes a different role of the pilot sitting in the cockpit.

The interaction with other systems

The T-Advisor is meant to be a tool for safety that is totally open to development and interaction with the systems from other manufacturers. That is why DSX is willing to share with others the knowledge gathered developing the T-Advisor and let the currently adopted system progress and develop. DSX is against the monopoly of the market independently from its own position: a monopoly is deadly for the advancement because the lack of competition doesn't push forward, it's bad for customers who can't bargain and who can't do anything else than accepting what is imposed without being able to choose between solutions with different performances, it's unacceptable for the aviation system when it comes down to talking about safety, because who can be sure that the imposed system has been checked by aviation experts and comply with basic operating rules that grant the safety sought ?
Allowing the presence on the market of other systems is the only way to promote the technical advancements that are the basis for the improvement and preservation of community interest. The need to have a global system that is constructively criticized and developed is basic if real safety is sought. On the contrary, an "unknown box" is installed onboard the aircraft, without the consciousness of how it performs the task that it is called to make. And the pilots shall rely on this.

From the technical stand point, the interaction of systems from different manufacturers deputed to the function of the traffic surveillance, is not a task that can't be completed within a reasonable time and cost.
As it has already happened in many other fields, from video and audio recording (think of the standards like VHS, Video 8, CD audio and all others) to aeronautics, where interaction among systems from different manufacturers is a reality, obviously it's possible to make these traffic advisory systems compatible among them as well.
The cost to achieve this compatibility is not going to sensible impact on price to the customer. There are already low cost systems able to notify correctly to the pilot the flight path of planes with transponders: this is an example of how a defined standard can be used by different manufacturers to offer different products. What is essential for the wide spreading of a safety system like the T-Advisor and Flarm ®, is the efficiency in operation and the low cost. An agreement to a standard would not cost more than today since it's clear that changing the "language" of interaction of the systems to a common one, isn't a radical change.
Once the exchanged data and the way they are calculated are defined, there is no big issue in making two systems interact properly, as other traffic warning devices adopted in aeronautics and other fields clearly demonstrate.
The only part of the system to be checked is the one that performs the two aforementioned operations: data exchange and their calculation, that are only a reduced part of the software needed to drive these devices and could also be separated from the rest of the code.
Any other issues about compatibility can be arranged agreeing on, for example, firmware updates dates and codes for preserving the confidentiality of the transmitted data among different planes in case of sport contests.

The different hardware that may be adopted is something that doesn't cause any problem for the use it is intended for (aeronautics): the most critical part is the GPS chip and, today, all modern GPS's offer a precision, both in static and dynamic behaviour, that is far higher than what is required for air traffic surveillance.

Although the T-Advisor is built using the top hardware available for the task, also other systems with components of different and lower quality and performance standards can be interfaced with it, as it has been demonstrated during more than one year of flight operation onboard tens of

aircraft, with some thousands hours of activity. The same fact that the T-Advisor has an operating range that is that larger than the other systems existent in the field, demonstrates the quality and the skills used for the design, development and production of the T-Advisor.
Hence, after the basic communication layer and interchanged data calculation have been set, the implementation of different human machine interfaces (HMI) or additional features and services of the systems can be left to each manufacturer for development.

Any argument about systems compatibility more complex than what stated above can be fictitious and aimed at avoiding the presence of different systems and, finally, keeping a monopoly in a market that needs the presence of more players to progress at a good pace.

The traffic avoidance systems market situation

From communications available on internet it can be read that:
"Flarm ® has been developed thanks to the support the Swiss glider clubs, which blindly placed orders for Flarm ® before it was even working. This was a crucial point .... The key is that many glider clubs were willing to risk some money and support the development."
This has been a great step ahead, showing that a progress can be made when there is an agreement on the requirements and a slender implementation procedure. The initial idea of implementing a traffic advisory system in sport aviation, based on the same principles already adopted in the maritime world, has been really good and we all thank Flarm ® to have promoted this safety system and brought it to production.

The project looked a real "gift" to the gliding world, since the promise was that of creating a system for the safety of the glider pilots, that would have used a protocol available freely to anyone to improve the safety network everywhere. This fact was also widely advertized ("FLARM ® is a universal patent free protocol, ..." , found on many documents in internet). Also in the Flarm ® forum there was a posting by the Flarm ® people saying that: "Es ist geplant, das Kommunikationsprotokoll von Flarm ® zu veroffentlichen (nahere Zukunft) sowie eine DLL und Source Code zur Verfugung zu stellen (nicht ganz so nahe Zukunft)." [basically the protocol has been promised to be free].

Monopoly situation
At the time being the market has widely adopted the Flarm ® system as a safety device against flight collisions. It is a device developed by glider pilots, whose functioning systems is not available for review by aeronautical specialists.
Through the secrecy kept on the radio protocol, the market is a monopoly, where the monopolist can change the communication between the devices at regular intervals, with the unique intention of keeping other manufacturers out of the market.
There are no technical reasons to change the transmission protocol.
Part of the safety of the pilots, about air collisions, is put into the hands of a system that only its manufacturer knows how it works and doesn't comply with any standard, not even aeronautical.
This situation has never existed in aeronautics and must not exist.

Since the number of Flarm ® units or units manufactured under Flarm ® license in operation was and is big, compared to the number of T-Advisor, it wouldn't have made any sense for DSX to try to establish a new standard. First of all for the sake of aviation, where we need a unique standard, properly defined and made available to manufacturers, and secondly it wouldn't have paid commercially.
It's therefore evident that DSX had and has all interest in adopting a standard that is commonly used for the traffic avoidance systems in the sport aviation.

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As a safety device, possibly able to save lives, a traffic avoidance system for aeronautical use shall comply with a set of rules, some of them already established through a history of accidents in the past. Without risking of making a low cost system too complex, which would drive the cost up and finally hinder its spreading, it is advisable to convey the experience already gathered in mid air collisions into this system. The relevant experts shall come to a round table to give their support and their independent point of view.

The Intellectual Property rights

The idea of broadcasting the position and motion data of a vehicle to be used by the receivers to warn about possible dangerous situations for collisions, is really old. In the maritime sector this concept has been put in place even before the advent of the GPS system. Obviously, when the GPS system became available, things got much easier. As a consequence, many studies, papers and requests for patents (and patents awarded) came up around the 80's, with people thinking at so many different solutions and arrangements that there is basically nothing left to invent in the field and is has become a sort of commonly spread knowledge.

For this reason, nowadays there are very low chances of having a recognized intellectual property on the subject of data transmission among vehicles, being these data used for traffic surveillance purposes or other ones. This is a fact well known to those who lately claim having IP rights in the field, but to whom patents have been denied because of presence of innumerous studies and patents dating back from the 80's and 90's that are easily accessible also through the world wide web. Pretending to patent a data transmission among vehicles today would be like asking for a patent of a cathode ray tube television: it's simply common knowledge. So far, no patents have been awarded on this subject and the requests have been rejected because of lack of innovation.

Some patents that date back from the 80's onward, are the following ones:

- "GPS relative position detection system"
- "Traffic collision avoidance system"
- "Satellite based collision avoidance system"
- "GPS-based anti-collision warning system"
- "Aircraft traffic alert and collision avoidance device"
- "Pilot's traffic monitoring system"
- "GPS relative position detection system"
- "Position identification system"
- "Aircraft location and identification system"
- "Integrated air traffic management and collision avoidance system"
- "Universal dynamic navigation, surveillance, emergency location, and collision avoidance system and method"
- "Encoding method for anti-collision system for sea navigation"
- "System for aiding the movement of moving units in group formation"
- "Method and apparatus for improving the accuracy of relative position estimates in a satellite-based navigation system"

And many more exist.

About radio protocols it must be said that they cannot be protected by copyright, hence also this aspect is public and available for use to anyone. Statements different from this one shall be substantiated.

There could hence be a situation where the field is open to any new product and the winner will be the one that performs better in the scope of safety.

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