



## New Approaches to Monitor GPS and FDR Parameters to Locate Aircraft Debris and Analyze Causes of Accident in Real Time

*K.P. Gowd\*, A. Khare\*\* and P. Yadav\*\*\**

*\*DSCC, EME Centre, Bairagarh, Bhopal, (MP)*

*\*\*Department of Electronics and Communication, UIT, RGPV, Bhopal, (MP)*

*\*\*\*Department of Electronics and Communication, SIST, Bhopal, (MP)*

*(Received 13 April, 2011 Accepted 28 May, 2011)*

**ABSTRACT :** The aim of this concept paper is to discuss the alternate methods for recording of aircraft/Strategic Missile performance parameters including GPS parameters, analyse and propose fail safe real time technology for accident investigation and location of debris in real time.

In this paper an attempt is made to improve the existing methods of flight data recording techniques to overcome the trauma of not able to locate the black box. Since modern day communications and inform technologies with large bandwidth are available coupled with faster computer processing techniques, the attempt made in this paper to develop a failsafe recording technique called "Automatic flight data recording and monitoring through aerospace platform in real time". Data mining/data fusion/data warehousing technologies are available for exploitation.

**Keywords :** Flight Data Recorder

### I. INTRODUCTION

In the field of aviation any aircraft accident involving either civil or military requires recovery of the blackbox or flight data recorder. It is a well known device in the field of aviation used for accident investigation. It is a device used to record specific aircraft performance parameters. Functions of flight data recorder and cockpit voice recorder have been confirmed into a single unit in some cases. Popularly known as a "black box" the data recorded by the FDR is used for accident investigation, as well as for analysis of air safety issues, material degradation and engine performance.

Flight data recorder popularly known as "black box" is a device used to records specific aircraft performance parameters. It has a specific special place in the field of aviation especially for accident investigation. In many cases even though the black box is designed, carefully engineered and shortly constructed to with stand the force of a high speed impact and the heat of an intense fire. Also modern FDR's are typically double wrapped, in strong corrosion-resistant stainless steel or titanium, with high temperature insulins inside. They beacon for up to 30 days, and can operate immersed to a depth of up to 6,000 meters.

### II. NECESSITY

In spite of all these measures some of the accidents similar to Air France flight 447 On 01 July 2009 do occur. It is very difficult to locate the black box. Hence, accident investigation will go clue less with many ifs and buts theories. To overcome this kind of cases availability of pool proof method of recordings of aircraft performance parameters is essential. The high tech submarines and other sea locating devices deployed by France and other nations in locating the 447 flight unsuccessfully is deplorable.

Another simple example of locating the BELL 206 Helicopter, accident occurred on 03 September 2009 carrying Andhra Pradesh Chief Minister in India became a mammoth task in spite of having fitted with emergency locating

transmitters. In this case rescue operations were carried out on war footing and the deployment of very large number of methods still found useless in locating the Helicopter debris in a forest not so dangerous. The following resources were deployed for locating the helicopter.

- (a) 5000 CRPF Personnel
- (b) 300 Army personnel
- (c) 8 Helicopters
- (d) ISROs unmanned aerial vehicles help
- (e) IRSA Imaging services
- (f) Calling of Air Superior Fighters fitted with real time high resolution imagery devices with Air to Air refuelling capabilities
- (g) Many local personnel
- (h) Desperately thinking to request US for help to locate the helicopter since US possesses real time satellite Imagery capabilities.

Indian Navy aircraft Kiran MK II of "Sagar Pawan" Aerobatic Team crashed at Hyderabad during India Aviation Show 2010, on 03 Mar 2010. The experts started airing the views attributing the reasons for crash that engine failure or flight control failure and so on.

In case of failure of a Strategic Missiles (Prirhvi in Sep 2010 and Agni in Dec 2010) after take of the tools for failure analysis are limited and based on experience/ assumptions/ simulations the conclusions are drawn.

A Pawan Hans Helicopter carrying Arunachal Pradesh Chief Minister crashed in May 2011 and it could not be located for five days in spite of following efforts.

- (a) 2000 Army, SSB and Police personnel
- (b) 150 ITBP men
- (c) 600 Bhutanese security personnel
- (d) 2000 Members of village Defence petrols

(e) Assam mobilises many villagers in bordering areas

(f) MI-17 Helicopter, IAF Helicopters and 2 Sukhoi- 30s

(g) Satellite Imagery by ISRO.

With these examples addition of bad weather adding to the chaos in locating the debris/Block Box needs a relook to find fool proof methods with latest technologies not only for locating debris/Black Box but also to know causes for accident/ failure to assist flight safety investigations accurately and instantly.

### III. PROPOSED METHODOLOGY

In the case of existing methodology following an accident, recovery of the “black box” is second in importance only to the rescue of survivors and recovery of human remains. On recovery is the flight data of aircraft performance parameters are transferred, in situ, to a solid state recording device and then periodically analysed with some of the same technology used for accident investigation.

The proposed methodology the parameters from flight data recorder including GPS data are transmitted to either a satellite or a ground station hub and recorded at that place in real time. The block diagram of the proposal is given below.

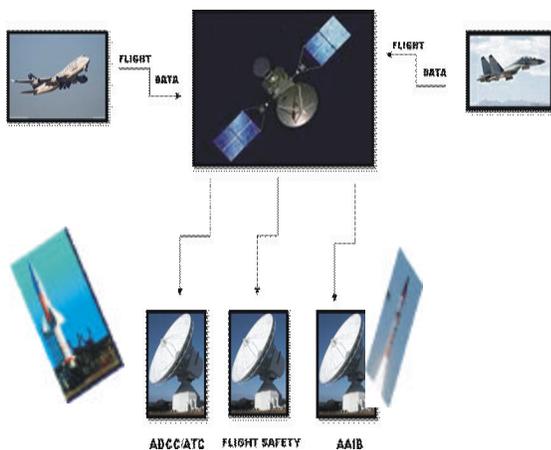


Fig. 1. Block Diagram of Live FDRs Data Recording system.

The concept here is to tap the parameters being recorded by FDR and transmit live either to a satellite or a ground station such as long range tracking radar and record them. Here appropriate place for locating the transmitting antenna is very critical on the aircraft.

FDRs are usually located in the rear of the aircraft, typically in the tail, hence antenna integration to the aircraft platform should be feasible. In case of Strategic Missile systems it is to be evaluated the positions to fit the FDR and its antenna. This can also be termed as Real Time Automatic Flight Data Monitoring and Recording Technology.

Till about 2002 only 29 aircraft performance parameters were recorded. Modern day FDRs are required to record 88 parameters as a minimum under current US federal regulations. These FDRs receive inputs via specific data frames from the FDAU units. And record significant flight parameters, including the control and actuator positions, engine information and time of the day.

### IV. DISCUSSION

The proposed live flight data recording system may not be viable for all air craft world over. For military flights aircraft it would be size and space constraints are expected since FDR data to be sensed after it records aircraft performance parameters and then transmitted to a control and monitoring station via satellite. Even this kind of data & fusion and handling network even though technologically feasible, may not be popular with aircraft operating over land. It would certainly be useful for trans atlantics and other civil aircrafts flying across continents over sea where even long range tracking radars can not provide surveillance and tracking cover. Also for military aircraft flying over hills and across sea, the proposed network can be very highly suitable. This system if implemented in Strategic missile systems, the reasons for failure can be instantly known in case of failure after takeoff.

The requirement is that of a complex IT data fusion set up involving several of the hardware, software, satellite platform, interlinking with ground control and monitoring station and several technologies. A solution comprising of following three technologies will be required for real time aircraft performance parameters from various FDRs of many aircrafts.

(a) Data warehousing for capturing and organising the data for fast near real time processing and retrieval of aircraft performance parameters.

(b) Content management for classifying and managing these parameters (mostly 88 from one FDR) in a well defined logical layout.

(c) Hierarchical storage management into various storage tiers based on the policies decided for timely availability for accident investigation and analysis.

### V. CONCLUSION

The main contribution of this paper is the availability of GPS parameters on line as proposed in this research paper will enable to locate the aircraft instantly and in real time.

The present methodology of accident investigation through recovery of black box over land is not suitable for long haul military and civilian transport aircraft. Transatlantic and other military and civil aviation air craft flying across continents over sea the proposed methodology in this paper is highly suitable. For Air France 447 flight victims families Air France is paying an advance of \$24,000. Later on it has to spend much more on this accident. The fixing of reasons is not feasible till FDR is located which is not possible. Hence the methodology proposed in this concept paper if implemented, the FDR data is available in near real time and will be a great assistance for finding out reasons of accident and may help to avoid future accidents. This is another main contribution from this research paper.

It may not be very easy to develop and install FDR with transmitting system for live recording of aircraft / Strategic missiles performance parameters but with present day technologies it is feasible to develop. In case of military/civilian transport aircraft due to availability of space and size it is possible to develop FDR with proper sensors and transmitting antenna to satellite further towards a monitoring ground station. On move communications are being used through mobile satellite terminals, hence suitable antenna can be fitted on to a civilian aircraft fuselage and

make FDR data transmission in near real time to a monitoring ground station through a satellite at least on routes transatlantic and other sea routes.

In case of difficulty in designing the FDR transmitter for all parameters it can be restricted to positional, engine and flight control parameters including GPS parameters. Advantages of this proposed system are as follows.

(a) The positional parameters such as Latitude and Longitude are recorded in real time and available at a controlling station.

(b) The Flight Safety parameters from Black Box are recorded in real time and are available at a controlling station.

(c) Court of Inquiry can be completed in 24 hours time since causes for accident can be inferred from the real time recorded flight parameters.

(d) It is an aid to improve flight safety and to avoid accidents.

(e) From the GPS parameters the location of debris can be instantly identified.

## REFERENCES

- [1] Wilbur L. Pritchard, Henri G. Suyderhoud and Robert A. Nelson, *Satellite Communication Systems Engineering*, 2nd ed., Dorling Kindersley (India) Pvt. Ltd., India, (1993).
- [2] M. Richharia, *Satellite Communications Systems Design Principles*, 2nd edition, MACMILLAN Press Ltd. (London), (1999).
- [3] Times of India Newspaper.