Safety-Critical Systems: Open Assessment 2009-2010

Hazard Analysis for the Integration of UAS into Controlled Air Space

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1. Introduction

Unmanned Airborne Systems (UAS) include both ground based control applications as well as Unmanned Airborne Vehicles (UAVs). There is a huge commercial interest in the development of UAS. They provide ways of reducing costs – for example individual ground control teams can operate several UAS. These systems can also be used to increase the endurance of surveillance missions, by keeping the vehicle in flight while ground crews are changed. UAS can also be operated in hazardous environments where it would not otherwise be safe for flight crews.

There are, however, concerns over the operation of UAS. For instance, most rely on communications links between the ground and the UAV. If these links are broken then the vehicle has to operate autonomously to avoid conflicts with other airspace users. Further problems arise because of the additional communications overheads that might arise between the ground crews and air traffic controllers who must help to manage the other aircraft in 'controlled air space'. It is for this reason that almost all UAVs operate in segregated areas so that they do not create conflicts for other aircraft/air vehicles. Your task in this assessment is to develop a tool that will support a hazard analysis for the integration of UAV's into controlled air space.

2. Tool Development

Your tool should enable senior or middle management in an Air Navigation Service Provider (ANSP) to assess the safety related risks that are associated with the integration of UAS into controlled air space. The design of the tool is entirely open. You may choose to use one of the risk assessment techniques that are introduced during this course, such as Fault Trees or Failure Modes, Effects and Criticality Analysis. Alternatively, you may choose to extend other approaches such as HAZOPs, or to develop entirely new techniques. The key aim is to help organizations assess the likelihood and consequence of hazards that are associated with UAS integration. The specific focus must be on identifying safety related risks and ideally to help managers mitigate those risks by appropriate planning before integration takes place.

Just as the design of the risk assessment tool is open, you are also free to use any technologies to support the implementation of your approach. The implementation of the tool could rely on simple web pages generated using HTML, PHP or any other associated technology. Your design may be realized using conventional programming languages. However, the marking scheme will take into account both the strengths of the design and the effectiveness of the implementation in terms of the support that they offer to the potential end users.

3. Evaluation

It is important that you evaluate your tool for hazard analysis. One means of doing this would be to ask a number of different users to try it out. For instance, one group might be asked to use an electronic hazard analysis tool while another uses a paper based form. However, this raises important methodological concerns. Firstly, how would you insure that both groups have the same level of expertise and background knowledge so that any comparisons are fair? Secondly, how would you go about assessing the accuracy of any risk assessments that are produced? Please consult with me before conducting your evaluation so that I can provide advice in answering some of these questions. You should also consult the course handbook and associated web pages that cover the ethical guidelines for user testing.

4. Transferable Skills

This exercise will provide a first-hand introduction to the challenges that face European aviation (see www.sesarju.eu). There is little common agreement on the best approaches to adopt and hence you will be working in an area of active research, which is also a focus for public, government and commercial interest. The exercise will provide some understanding of the problems that can arise in preparing for low probability, high-consequence events. It will also underline the uncertainty that often characterizes risk assessment in safety-critical engineering. Many of the skills provided by this assessed exercise are in scarce supply.

5 Assessment Criteria and Submission Details

This exercise is degree assessed. It contributes 30% to the total marks associated with this course. The body of the report should not exceed fifteen A4 pages. The report must be printed out and must be submitted in a secure binder. It must include:

- A title page containing your contact details (email etc);
- A table of contents and appropriate page numbers;
- A section on the tool that you developed.
- A section on the evaluation method that you used.
- A results sections.
- Conclusions.

In addition to the fifteen pages in the body of the report, you may also include appendices. These should contain the listing of any code used during the study together with suitable acknowledgements for the source of code that has been borrowed from other programmers. The report should be handed in on Wednesday 2nd December 2009 using the secured boxes in Lilybank Gardens. Please make sure that you keep back-up copies of all of your work and include a plagiarism statement using the standard 'pink form'. The following marking scheme will be applied: 15 for the method; 10 for the results; 15 for the conclusion; 10 for the technical documentation. All solutions must be the work of the individual submitting the exercise and the usual plagiarism form must be attached to all solutions.

References

C.W. Johnson, Insights from the Nogales Predator Crash for the Integration of UAVs into the National Airspace System under FAA Interim Operational Guidance 08-01. In J.M. Livingston, R. Barnes, D. Swallom and W. Pottraz (eds.) Proceedings of the 27th International Conference on Systems Safety, Huntsville, Alabama, USA 2009, International Systems Safety Society, Unionville, VA, USA, 3066-3076, 2009. Available on: http://www.dcs.gla.ac.uk/~johnson/papers/ISSC09/UAV_FAA_Integration.pdf

C.W. Johnson, Act in Haste, Repent at Leisure: An Overview of Operational Incidents Involving UAVs in Afghanistan (2003-2005. In P. Casely and C.W. Johnson (eds.) Third IET Systems Safety Conference, NEC, Birmingham, UK, 2008, IET Conference Publications, Savoy Place, London, S2008.
http://www.dcs.gla.ac.uk/~johnson/papers/UAV/Johnson_IET_UAV.pdf