ICAS 2008 Abstract

Submission for:
1. Aircraft and Systems Integration
- Unmanned Aerial Vehicles

Oral presentation preferred, poster presentation optional

Real Time Simulation of Integration of UAVs into Airspace

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Unmanned Aerial Vehicles (UAVs) gain increasing attention in aeronautics, especially as also civil applications open up for their use. From the view of the design of unmanned aircraft, most problems can be solved as technology does not differ much from that of existing aircraft. However, the integration of UAVs into non-segregated airspace is a remaining important issue which has to be solved soon with highest priority. One tool to validate concepts for integration of UAVs into airspace are real time simulations.

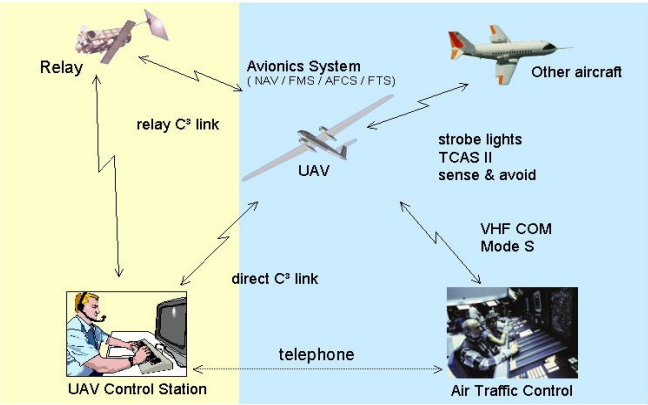

Fig 1: Concept for integration of an UAV system in ATC/ATM

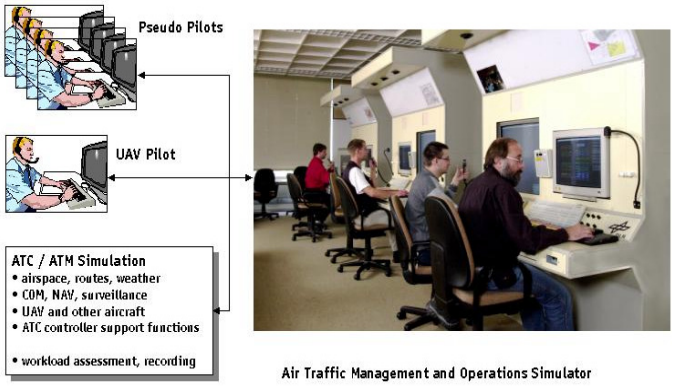

Fig 2: Simulation concept for ATC UAV simulation

Fig 1 shows the concept which was developed and further investigated using the real time simulation. The UAV is remotely controlled from the control station on ground, either by direct data link or satellite relay. The integration in ATC/ATM is done via radio communication of the UAV pilot with ATC. For this, the UAV acts as transmission relay. Hence in this concept, the ATC does not observe any difference between an unmanned or manned aircraft.

Fig. 2 shows the set-up of the simulation trials with the especially configured DLR Air Traffic Management and Operations Simulator. It represents an ATC radar simulator which allows to simulate the basic working environment of an 'air traffic control officer' (ATCO) whose task is to control the air traffic by means of radar situation displays, electronic flight strips (to visualise flight plan information), radio voice communication with aircraft, and telephone communication with neighbouring control sectors or other ATC control centres. The

simulated traffic in these two sectors is piloted by so-called pseudo pilots, who are navigating the aircraft according to predefined individual flight plans as well as to advisories or clearances given by ATC controllers in the respective sectors. To this system an UAV ground control station is added including a simulated data-link.

Different trails with one or two medium Altitude Long Endurance (MALE) UAVs flying in the Frankfurt airport area have been carried out. The scenarios included emergency procedures including emergency landing in Frankfurt. The UAV-pilot to ATCO interactions have been investigated by Instantaneous Self Assessment questionnaires as well as by NASA Task Load Index methodology. Fig. 3 shows an example of the results of NASA TLX workload determination of the controllers for different trials. The trials started with the baseline of the normal traffic. Later on, 2 UAVs have been added into the airspace. It could be shown, that the workload increased, which was due to the "new" behaviour of the type of aircraft.

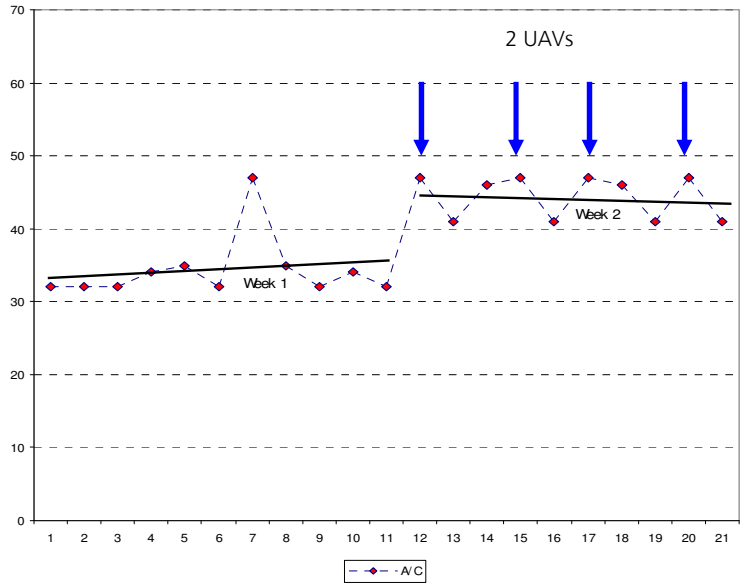

Fig 3: NASA TLX workload vs. trials without (left) and with UAVs (rigth) included in airspace

One integration concept proposes to apply the standard emergency codes 7600 (communication loss) and 7700 (emergency situation) as for manned aircraft, but to introduce additional extended emergency codes for the case of data link loss to give additional information on the further intent of the UAV, i.e:

- 7660 for data link loss, proceed as planned
- 7661 for data link loss, return home,
- 7663 for data link loss, fly to emergency field

After having simulation runs with the extended emergency codes the controllers came to the conclusion that the standard codes 7600 and 7700 are appropriate also for UAVs. The extended codes would implicate that they need to be implemented world-wide, thus requiring additional effort for implementation and training of controllers. The simulation runs showed that a UAV emergency can be handled as easy as an emergency of a manned aircraft.

- 7700 shall be used only in emergency cases where the behaviour of the UAV is not predictable at all and an immediate change of flight path i.e. to an emergency landing field is necessary.
- 7600 for communication loss shall be used as long as the behaviour of the UAV is predictable.

One objective of the integration concept for UAVs in ATC/ATM was to show that UAVs can be treated like manned aircraft. It was proven that standard procedures for manned aircraft were also applicable to a UAV. No specific problems with a UAV in controlled airspace were observed.