AUTOMATIC SPEECH RECOGNITION IN AIR-GROUND DATA LINK

by

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Abstract

In the present air traffic system, information presented to the transport aircraft cockpit crew may originate from a variety of sources -- the airline company, weather service, or air traffic control -- and may be presented to the crew in visual or aural form, either through cockpit instrument displays or, most often, through voice communication. But voice radio communications are the most error prone method for air-ground data link. Voice messages can be misstated or misunderstood and radio frequency congestion can delay or obscure important messages.

The data link of the future will offer more options for presentation of information and probably less reliance on voice communication. Discrete electronic addressing of data will allow information to be fed directly into the aircraft's flight management system. This could lead to a proliferation of output devices in the cockpit, each competing for the attention of the crew and presenting distractions during periods of workload variability.

To prevent this proliferation, a multiplexed data link display can be designed to present information from multiple data link sources on a shared cockpit display unit (CDU) or multi-function display (MFD) or some future combination of flight management and data link information. Furthermore, the data link interface will have the capacity to store messages that can be called up by the crew or presented automatically during periods of lower workload or during the appropriate phase of flight. In this way, critical information will be presented immediately, while lower priority information will be stored until needed or wanted.

An aural data link which incorporates an automatic speech recognition (ASR) system for crew response offers several advantages over visual displays. First, an aural system eliminates the need for a separate display unit. Information can be presented visually on the CDU or MFD when requested by the crew, thus limiting the time sharing of the unit to periods when it least interferes with flight management functions. Second, the presentation of information in more than one media, visual and aural, is likely to increase retention and recall. Also, the aural presentation is more likely to get the crew's attention during

periods of high workload while ASR input leaves the crew's eyes and hands free to complete other tasks. Finally, aural presentation with ASR input is more natural and offers the least variation from the present environment.

A variation on this approach is an interface which can present information in various formats (aural, visual, or printed) as appropriate to the crew workload. Thus, during a period when the crew's visual workload is already high (e.g. scanning instruments during a critical phase of flight) high priority information might be presented aurally and stored so the crew can call it up visually later when desired. Lower priority information is stored and presented when appropriate, so as not to overload the crew with information at critical times. Such a system requires some means for the interface to measure and determine the crew's current workload -- perhaps by "listening in" on radio transmissions, monitoring TCAS or control movements, or monitoring crew activity in some way. The interface computer then decides whether to store or present the information and the most appropriate medium for presentation.

A number of questions exist about the efficiency of a computer mediated aural/ASR system. What indicators of workload should be used and how should the computer decide presentation media? What is the effect of inconsistency in the form in which information is presented? Would the system reduce or increase crew data entry errors? Is speech input faster and more accurate than manual entry? Would the system improve or degrade information retention and recall? How will information priorities be set? How well will crews accept the system? These and other issues require further research.

The purpose of this summer's work was to begin an investigation of the possibility of applying ASR to the air-ground data link. The first step has been to review current efforts in ASR applications in the cockpit and in air traffic control and evaluate their possible data link application. Next, a series of preliminary research questions is to be developed for possible future collaboration.