Human Factors of Precision Taxiing under two levels of Automation

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New air traffic control concepts and automation tools designed to improve the capacity of the National Airspace System are continually researched, including those that test early prototypes and their impact on the operators to adequately perform the task at hand. This study investigated the workload, situation awareness and other human factors issues related to using a prototype surface automation tool (“GoSAFE- Ground Operations Situation Awareness and Efficiency Tool”) for managing precision taxi operations, with increased traffic relative to current day operations. Our team of controller participants working four air traffic positions handled airport traffic using GoSAFE under two different levels of automation: (1) Mixed voice/datalink [partially equipped] and (2) Datalink only [fully equipped]. The study found statistically significant differences on workload due to automation level. The impact of automation was also investigated for the four air traffic control positions. Results on one situation awareness measure were largely consistent with the workload findings. While realizing these differences, workload and situation awareness levels remained manageable and reasonable across all conditions and positions. Our controller participants also reported acceptability and feasibility ratings and provided feedback on the usability of the user interface. Results suggested that the GoSAFE automation helped the participants cope with the differences in their respective areas of responsibility and an increased volume of traffic, while maintaining adequate information resources required for effective air traffic control operations. The study-participants did have difficulty with some of the interface characteristics of the automation tool, such as use of color and data block size. As with any prototype surface automation tool, additional research and development needs to address these types of issues in order to insure effective use of the tool. This research will make it possible to ascertain the future impact of the tool on other system characteristics such as throughput and safety.
Towards Higher-Level Services of an Advanced Surface Movement Guidance and Control System (A-SMGCS)

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The high number of runway incursions and weather dependent airport throughput occurrences has led to the development of an Advanced Surface Movement Guidance and Control System (A-SMGCS). A-SMGCS’s basic levels 1&2 support tower air traffic controllers through the provision of a weather independent complete traffic situation and a basic runway safety net. Level 1&2 are already validated and operational at nearly 20 European airports. Instead of the higher-level services of an A-SMGCS, such as routing, departure management (DMAN), clearance conformance monitoring, data link communication (TAXI-CPDLC), and onboard guidance are not fully developed so far. The A-SMGCS manual [ICAO, 2004] describes operational, functional and performance requirements for all services but for the higher-level services they are rather immature or nonexistent. Therefore, EMMA2 (European Airport Management by A-SMGCS, part two), an Integrated Project of the 6th European framework programme, was launched in 2006. In EMMA2 a holistic A-SMGCS concept, including the higher levels, was developed. This concept describes all A-SMGCS services including detailed procedures and operational requirements. It was tested in extensive simulation and field trials at four European airports (Prague Ruzyne, Milan Malpensa, Toulouse Blagnac and Paris Charles de Gaulle), using diverse technical solutions and test platforms. The most important results and recommendations are presented in this paper.

Evaluation of Mixed-Mode Data-Link Communications for NextGen 4DT and Equivalent Visual Surface Operations

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By 2025, U.S. air traffic is predicted to increase 3-fold and may strain the current air traffic management system, which may not be able to accommodate this growth. In response to this challenge, a revolutionary new concept has been proposed for U.S. aviation operations, termed the Next Generation Air Transportation System or “NextGen”. Many key capabilities are being identified to enable NextGen, including the use of data-link communications. Because NextGen represents a radically different approach to air traffic management and requires a dramatic shift in the tasks, roles, and responsibilities for the flight deck, there are numerous research issues and challenges that must be overcome to ensure a safe, sustainable air transportation system. Flight deck display and crew-vehicle interaction concepts are being developed that proactively investigate and overcome potential technology and safety barriers that might otherwise constrain the full realization of NextGen. The paper describes simulation research examining data-link communications during four-dimensional trajectory operations and equivalent visual surface operations. Overall, the results indicate that retaining or replacing party-line information with a voice-by-exception data-link can have significant safety impacts for surface operations.