International Civil Aviation Organization

ICAO **Thirteenth Meeting of the Air Traffic Management Sub-Group (ATM/SG/13) of APANPIRG**

Singapore, 25 – 29 August 2025

Agenda Item 8:   Any Other Business

IMPROVEMENT STRATEGIES FOR FATIGUE DETECTION AND MANAGEMENT OF AIR TRAFFIC CONTROLLER

(Presented by China)

SUMMARY

This paper presents the critical issue of fatigue Detection and Management of Air Traffic Controller, which poses significant safety risks due to impaired judgment and delayed reactions. The goal of ATMB CAAC is to develop a comprehensive strategy for detection and management fatigue, including algorithm, system and duty schedule. This would improve overall flight safety and reduce human error caused by fatigue.

1.   INTRODUCTION

1.1   With the rapid development of civil aviation, air traffic controllers, as key personnel ensuring aviation safety, may experience increased workloads and fatigue due to the surge in flight numbers. Fatigue is a major contributor to civil aviation incidents and has become a serious threat to aviation safety.

1.2   Fatigue research is often conducted from both subjective and objective perspectives. Subjective aspects are often addressed by establishing fatigue scales, with controllers conducting self-assessments before and after work shifts to compare fatigue standards and hence determine whether they are fatigued. Objective approaches include fatigue-recognition methods based on speech, eye movements, facial expressions, and physiological parameters such as the heart rate, blood pressure, and EEG.

1.3   Aviation safety reports indicate that fatigue is a key contributor to flight delays, emergency situations, and accidents. When controllers are fatigued, their decision-making abilities and reactions are significantly impaired, especially during complex control tasks or unforeseen events.

1.4   This proposal aims to explore and establish a fatigue management strategy specifically for the Chinese aviation industry. It includes the Fatigue Detection Technology, Duty Schedule of Air Traffic Controller, Joint Situational Awareness between Air Traffic Controller and Pilot. The proposal recommends the creation of a comprehensive Fatigue Detection and Management System optimizing controller work schedules and rest periods, and introducing advanced fatigue detection technologies to reduce fatigue-related safety risks.

2. DISCUSSION

Multi-modal based Fatigue Detection Technologies

2.1   Existing methods for extracting and fusing fatigue features encounter two main challenges: (1) the low accuracy of traditional single-mode fatigue recognition methods, and (2) disregarding multi-modal data correlations in traditional multi-modal methods for feature concatenation and fusion. An interactive algorithm for the fusion and recognition of multi-mode fatigue features that combines multi-head attention and cross-attention which are based on a speech, facial and Heart Rate.
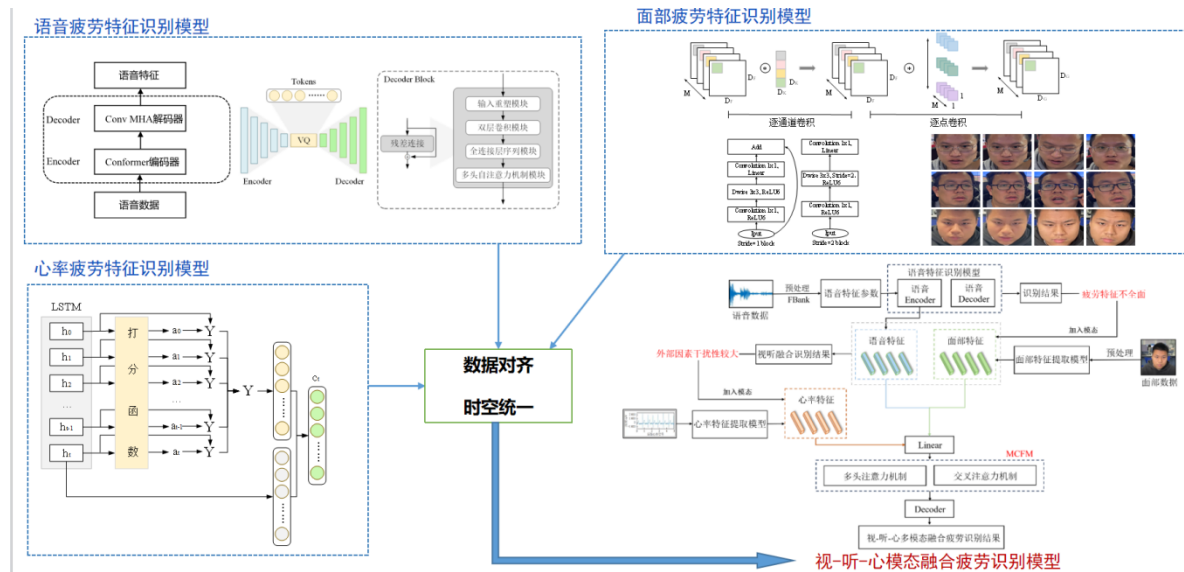

Optimizing Duty Schedule of Air Traffic Controller

2.2   According to fatigue management results, it is essential to rationalize duty schedules, avoiding extended periods of continuous control workload. Air traffic control units should implement shift systems that ensure adequate rest, particularly after long-haul or lobster-shift, allowing for sufficient recovery time.

Joint Situational Awareness and Management between Air Traffic Controller and Pilot

2.3   Against the backdrop of rapid development in the aviation industry, air traffic management faces three major challenges: 1) Air traffic controllers and pilots face more complex operational environments; 2) The high volume of operations and high route density have led to increased workload and lack of situational awareness among controllers and pilots; 3) Existing research mostly focuses on individual cognition, neglecting the impact of the interaction between controllers and pilots on flight safety. The situational awareness of controllers and pilots conducts a hierarchical analysis of air-ground integrated flight conflict scenarios through the STPA. Combined with the fatigue recognition technology of radiotelephony, a STPA air-ground integrated situational awareness analysis model based on radiotelephony is proposed to predict potential conflicts in advance and improve the accuracy of situational awareness. The results indicate that the model not only helps to improve flight safety and efficiency, but also significantly enhances the collaborative work level between controllers and pilots, strengthens their situational awareness and communication effectiveness.
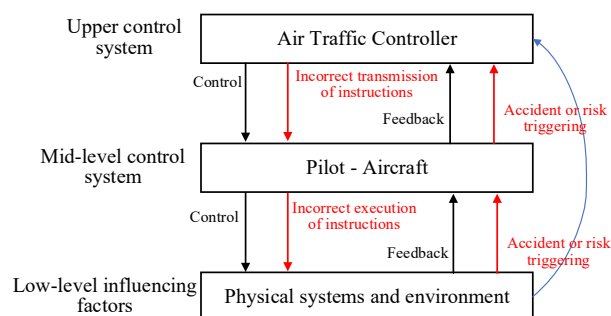
Developing a Fatigue Detection and Management System (FDMS)

2.4   The proposal suggests establishing a comprehensive Fatigue Detection and Management System (FDMS). This system should include fatigue monitoring, early warning systems, and data analysis capabilities, generating real-time fatigue risk assessments. ATC units could use this system to monitor fatigue levels in real time, adjusting duty schedule or making safety decisions based on the results.
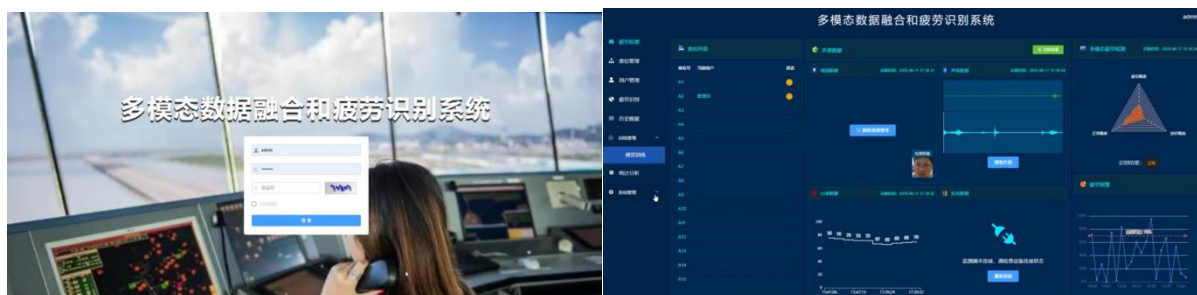
3.   ACTION BY THE MEETING

3.1   The meeting is invited to note the information contained in this paper.

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