Extended reality for Future Air Mobility

In accordance with the increasing passengers' expectations of commercial flights, cabin comfort is becoming one of the most important parameters for both the design of future aircraft and for the update of the existing ones. Moreover, cockpit comfort and ergonomics could deeply affect the performance of pilots, especially during long-haul flights, leading to increased psychophysical fatigue and thus to reduced safety of operation. Thus, the increase in cabin/cockpit comfort drives the aeronautical industry to develop new HCD procedures that aim to take into account the passengers'/pilots' well-being perception and response to the external stimuli coming from the flight environment. In this framework, the Digital Twins can be used to increase the quality of parts and systems used in aircraft production extending the concept to the upgrade of aircraft comfort for both the passengers and pilots.

On this basis, the general objective of the project is to use and/or develop Digital Twins of a real aircraft, such as flight simulator, extended reality and numerical codes, to set up design tools and procedures for comfort improvement taking into account the human perception and response, with particular regards to the different cabin layout and to Noise & Vibration - N&V. To these aims: i) a full flight simulator will be used to assess the human perception of comfort and to evaluate human response and performances under different layout and N&V levels; ii) extended reality will be used to provide different cabin/cockpit layout and environment to the passengers during a simulated flight; iii) numerical tools will be implemented to analyse new class of materials to be used as passive technologies for the N&V attenuation. The aforementioned three aims will be integrated in such a way that the numerical tools will allow to define the N&V levels to be simulated with the FFS allowing for the experimental evaluation of the N&V level influence on the human comfort and perception of the surroundings cabin environment. The objectives of the project thus involve the use and or the development of three Digital Twins tools, described below, aiming at the modelling of different cabin layouts and of different materials and structures for N&V whose effects will be directly tested on passengers and pilots by means of a full flight simulator.

Within the project, specific activities related to the integration of Extended Reality technologies are required.

The project will exploit multisensory XR environment encompassing different human senses for a holistic approach to the comfort assessment for the design of future aircraft passenger cabins. eXtended Reality (XR) refers to all possible combinations of real and virtual environments along with advanced human machine interaction tools. Technologies used for XR are Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR). Figure 6 shows an adaptation of Milgram and Kishino reality – virtuality continuum where the transition from fully real environments to the virtual ones is considered as a continuum, with no – specific dividing points between adjacent technologies, including all possible variations that can blend real and virtual objects to provide the user with an XR experience.

This project aims at defining a tool that can be tailored within a set of XR solutions ranging from virtuality to augmented reality depending on the testing environment it is meant for. By means of the above-mentioned tool, it will be possible to immerse the user in the cabin’s virtual environment, i.e. in the absence of any physical mock-up, as well as provide the user with augmented reality when he/she is within a cabin physical mock-up or a flight simulator cabin. To achieve that, the blend of real and virtual information presentation is optimized based on the testing environment where the user is immersed. Overall, the proposed system (Fig. 7) will enable to visually and auditory stimulate the user and allow interaction as he/she would be in the newly conceived cabin design solutions, maximizing the effectiveness of human-centered design procedures in every phase of the design, by exploiting both virtual and augmented physical mock-ups.

Plan for activities:

- Choose and set up sensors for objective evaluation in cooperation with project partners
- Development of a vibro-acoustical model of the cabin interior in cooperation with project partners
- Vibro-acoustic interior design optimization in cooperation with project partners
- Definition of the Extended reality models for different cabin/cockpit layout
- Design and development of the visual layer of the multisensory XR environment
- Design and development of the auditory layer of the multisensory XR environment
- Integration of the models in VR/AR tool and within the testing environments in cooperation with project partners
- Reporting
- Participation to scientific conferences