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# Cognitive and Action Sequence Prediction using Deductive Reasoning

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## Content

Early in the process of the development of an aircraft cockpit, although the designers always introduce a set of operational procedures with the expectation that all pilots would follow, it is very difficult to guarantee that the flight crew will do exactly they are expected to do. The deviation of the pilots' operation from the intended procedures may lead to an unsafe situation, and could also be an indication to the inherent reason for the biases in the pilots' cognitive process. It became very obvious that a tool that could help to predict a comprehensive set of possible operations that the pilots would operate the aircraft will be very useful both in the flight deck design process and pilot training practices.

This paper presents the development of the researches in the "Cognitive and Action Sequence Prediction using Deductive Creation Theory (CASEPREDICT)". Unlike any human-made system which the response of the system can be predicted to certain degree of accuracy, a human-in-the-loop system is always associated with a great deal of uncertainty issues which comes from the cognitive process of human operators. The researches has been centered around flight crew cognitive model and involved the works in the following aspects,

- 1) The decomposition of the intended tasks into the crew operations in both physical and cognitive activities
- 2) An analytical process of the dynamic crew situation awareness procedure
- 3) The biases of decision making process due to the combination and the temporal sequence of the incoming information
- 4) The temporal and precision uncertainties in operational actions
- 5) Modeling of the pilot-in-the-loop system and virtual experiments that generate the system behaviours
- 6) Experimental methods for obtaining the parameters and characters of the interactions between the pilots and aircraft system
- 7) The hierarchy pilot response modes
- 8) The extraction of operational habits and influential factors
- 9) Training levels and skill transfer

In order to record and analyze the deduced cognitive and action sequence, a set of coding rules was also developed, and further performance and workload analyses can be conducted.

The presented work has been a set of combined research activities since 10 years ago and the research results were turned into a software-based development tool. With designated interface to design layout of the flight deck and functional allocation, the program was successfully applied to the development and evaluation of the flight deck, including the investigation of correctness and efficiency of the flight deck function allocation, flight crew workload for given task procedure and the training courses.

**Keywords :** Man-machine cooperative techniques