

# Safety consideration of the optionally-piloted airplane landing

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In-flight testing of automatic control systems requires the need to take into account various safety aspects. Especially during the flight phase in the proximity of the ground, as take-off and landing, incorrect control of the aircraft poses a threat to the aircraft itself as well as objects and people on the ground. In the case of control systems intended for a larger aircraft, it is possible to carry out tests using a manned aircraft with a safety pilot. The presence of a pilot who can take control in the situation of improper operation of the tested system appears to solve safety problems. However, it should be remembered that effective and correct safety preserving action requires a correct assessment of the situation and a timely response. Pilot needs to know manifestations of incorrectness for the proper assessment of the control system operation and detection of its failure or erroneous action. Continuous control process analysis is based on incoming data and knowledge on the controller assumed operation. The analysis what information is necessary for this task is crucial for development safety pilot cockpit. At the first information content presented to a safety-pilot should be determined. But also analyzing the stages of the decision-making process, it is necessary to find such form of presentation, which enables fast assessment of the actual condition in emergency state.

The analysis of possible situations of malfunction of the control system results in the possibility of counteracting the danger. An assessment of whether these are natural pilot skills or additional procedures are necessary shall determine how the pilot will be prepared for the flight tests.

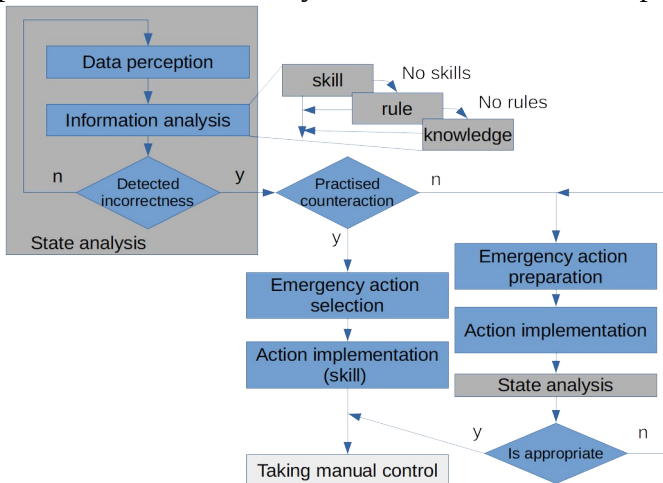


Fig. 1. Schematic of state analysis and preventive action

In the case of practiced actions (fig. 1) the response is fast (based on skills and rules). In addition, learning how information changes in a given situation, also speed up this stage by automating assessment of the state.

New situation may be difficult to properly evaluated and as this process is knowledge-based time of assessment may be long. Sometimes some correction is necessary.

Simulation tests are convenient method for determining possible dangers or potential hazards, by performing a series of simulated flights in which incorrect actions or equipment failures are deliberately entered. Comparing the performance in a given test scenario with the

correct operation allows us to determine which variables and how they inform about certain situation. It also shows if the test scenario or particular mode of operation may cause danger. Sometimes the relevant danger assessment is available on the basis of typical data presented in standard way in the cockpit, but in another cases only such information is inappropriate or causes too long delays in pilot response.

In the article will be carried out an analysis of the landing control process. Simulation tests will identify hazards that may result from incorrect control and the influence of external factors in the form of air streams during landing. Different parameters of the approach trajectory will be tested for the purpose to find safety margins.

During testing, the aircraft's motion model with landing gears suspension reactions is used. Checking both the aircraft's body attitude and the suspension forces allows you to assess the correctness of the control applied before and during the touchdown and in the taxi phase.

The result shows that the 3deg path landing for the assumed aircraft class is safe if pilot analyses aircraft state in the normal way similar as instructor pilot during pilot training. Also the omission of the flare does not affects safety considerably.

But possibility of incorrect action on elevator or another control surface needs pilot attention especially when an aircraft is close before and during expected touchdown.