Thesis

Development / Enhancement of a Procedure Validation Tool

Background:

As unmanned and optionally piloted aircraft systems (UAS/OPV) evolve, the need for valid, certifiable, and traceable operational procedures becomes increasingly critical. While systematic methods for generating procedures (e.g., via procedure-based ConOps development) exist, the challenge of validating already-developed procedures remains largely unresolved. This thesis addresses that gap.

The goal is to explore different validation strategies for already generated SOPs, such as expert reviews, simulator-based testing, structured checklists, and possibly automated or AI-assisted validation tools. Based on this evaluation, the thesis should identify the most promising and scalable approaches.

A prototypical tool (e.g., Python-based) could be developed or extended to support (semi-)automated validation. The student is encouraged to explore both symbolic and AI-based validation frameworks but can also propose hybrid or rule-based methods.

Task Description (description is only a suggestion—feel free to reach out with similar ideas in this field):

- Research & Classification of Validation Strategies:
    - Literature review on existing validation methods for procedures in aviation and related domains, including a identification of strengths/weaknesses
    - Evaluation of applicability for UAS/OPV SOPs
- Exploration of Automated Validation Techniques:
    - Analysis of rule-based, logic-based, or AI-based techniques (e.g., NLP, LLMs, graph structures)
    - Definition of validation criteria (completeness, consistency, traceability, redundancy)
    - Design of a prototype tool for (partial) automation
- Prototype Tool:
    - Analyze the existing procedure validation tool and identify areas for improvement
    - Tool concept and architecture for supporting or automating SOP validation
    - Implementation of core functionalities:
        - Check whether all requirements are met
        - Identify unmet requirements and report them
        - Detect missing, duplicate, or incorrect procedures
    - Design and implement a database that maps the entire DA42 OPV operation, covering:
        - All procedures and their dependencies
        - Operational conditions
        - Links between procedures based on flight phases and requirements
    - learning of KI Model
    - Demonstration and validation using selected DA42 OPV procedures
- Discussion and Reflection:
    - Comparative evaluation of validation methods
    - Feasibility, scalability, and effort analysis
    - Recommendations for future tool development or process integration
    - Summary of findings and identified best practices

Required Profile of Qualifications:

- Diligent and structured working methods and high level of commitment
- Basic knowledge in aircraft operations, SOP structure, and aviation systems
- Interest in system validation, tool development, or AI-based methods
- If following the AI approach, a strong AI knowledge shoult be there
- Basic knowledge of Python and database management (other tools than Python are also okay)
- Understanding of aircraft operations and procedure validation is beneficial

Submission Guidelines:

- The thesis should be written in English (however, german is possible) and follow the standard academic format
- Use of credible and up-to-date sources is mandatory
- Start date: Any time