Projects 2025–

Friendly TMA: Towards Deployment of Dynamic TMA Arrival Routes

2025-2028

This project is a continuation of a series of research projects (ODESTA, ODESTA-PM, IFWHEN, TMAKPI, IWA), where our group has developed developed and matured the mathematical optimization framework for automated deconfliction of environmentally-friendly aircraft arrivals. In the FriendlyTMA project, we will further develop the so-called dynamic STARs, aircraft arrival routes, calculated using this mathematical optimization framework. The solution enables automated de-confliction of arrivals with minimal environmental impact and features weather and obstacle avoidance. It is robust against overcapacity and partial airspace closures. This solution will be evaluated and validated by air traffic controllers and pilots, with the goal of developing decision support tools to monitor dynamic routes, which will improve the predictability of arrivals and enable their automatic time-based separation from each other, from UAM, and from hazardous weather.

CONTRA (Contrail Minimization Strategies and Their Impact on Aviation Efficiency: A feasibility Study)

2025-2028

Aviation industry is facing multiple climate and weather challenges, one of which is the impact of condensation trails, or *contrails*, which are ice clouds that form as a result of the mixing of cold, humid air with aircraft engine exhaust plumes. Contrails trap outgoing terrestrial radiation and counteract emission reduction benefits from emission-optimized flight routes. The formation of persistent contrails has been recognized as a potential threat to the global climate.

In this project, we

- study the most recent state-of-the art data-driven approaches and modeling solutions for prediction and avoidance of the regions prone to contrail formations, and then apply them to quantify the global impact of the potentially contrail-forming flights in Swedish airspace. Then we will extend the scope and compare our findings to the most recent developments in other regions inside and outside the EU.
- consider alternative contrail mitigation strategies and evaluate their impact on aviation efficiency. A series of workshops with the relevant experts are planned for this activity.

- develop mathematical models and algorithms for efficient evaluation of capacity reduction in the en-route airspace sectors due to potential implementation of the proposed contrail avoidance strategies on different altitudes in various weather scenarios.
- evaluate additional emissions (fuel burn and non-CO2 emissions), safety risks and other performance metric metrics potentially degraded due to proposed rerouting.
- consider the cost of delay associated with the proposed mitigation strategies and explore the economic incentives towards stimulating the environment-saving behavior among the stakeholders.

This is a collaborative project with AVTECH company and LFV (Swedish ANSP).

Publications:

S. Bohman Axelsson, T. Elneros, O. Jerreling. A literature Survey on Aviation Contrails. MS course project work. Paper, Slides.

IFAV V3 (Increased Flexibility of ATCO Validations) Intro video

2023-2026

Growing traffic numbers, environmental aspects and cost effectiveness issues create a huge demand on the Air Traffic Management to continuously optimize its processes and use of resources. One key resource is the availability air traffic controllers of the air navigation service providers. Due to current regulations and practices, the deployment of air traffic controllers to a specific airspace or unit is restricted by unit endorsements, as controllers have to be comprehensively trained on local procedures and circumstances. The research proposed in this project aims at enabling a more flexible deployment of ATCOs to sectors. This is a very wanted and eagerly awaited improvement in ATM, because it would improve its cost efficiency by Millions of Euros that could be saved yearly in the European Union. The concept behind increased flexibility of ATCO validations (IFAV) are various flexible endorsement strategies, that are based on technical enablers, like specific controller assistance systems that provide support on sector specific procedures and rules and/or procedural enablers, like for example ATC task standardization. Based on prequel SESAR solutions (such as PJ.33-01a/b and PJ.10-73 IFAV), this new project will continue the IFAV work done in upper area control, and progress it to V3 / TRL6 maturity. This will be the main part of the project. In addition, about 15% of the project will be spent to transfer the know-how to another beneficial and similar use case: the application of IFAV in a remote tower center. This project proposes two solutions that correspond to the described activities, and will include eight validation exercises. The consortium consists of 13 partners: 5 ANSPs, 2 universities, 1 big industrial partner and 5 research organizations.

OWL2 (On WorkLoad Measures)

2025-2027

Being able to estimate air traffic controllers' (ATCOs') workload is considered a safety barrier that currently depends on operators' subjective self-estimation, as empirical studies often use ATCOs' self evaluation using numerical scales. However, target fixation (such as attentional tunneling, which describes the neglect of other critical stimuli) and mental fatigue are known phenomena that reduce operators' ability to accurately estimate their own workload. Being able to support the self-estimation based on empirical measurements would set the basis for a WL monitoring system. In the preceding research project OWL (On Workload Measures), a simulation study was conducted.

OWL2 project aims to better understand the relationship between objective indicators and the ability to predict WL using non-invasive methods. The primary focus will be on identifying and analyzing sources of uncertainty through sensitivity analysis. For example, it remains unclear how accurately workload can be predicted for individuals not being included in the training data set. We consider individual differences as a predominant source of uncertainty. A secondary focus will be on mitigation strategies. This involves e.g. an extension to alternative physiological and behavior-based workload indicators, including operator voice, visual scan pattern and heart measurement. Our analysis will use the high-quality, existing data collected in the scope of OWL in 2023, which is suitable for the objectives just mentioned (and no further data collection is needed).

OWL (On WorkLoad Measures)

FINISHED

2023-2025

Identifying possible situations of too high or too low workload (overload or underload) is critical for various operators; given the tasks of an air traffic controller (ATCO), this applies in particular to air navigation service providers (ANSPs) following the implementation of changes that alter task definitions. However, to identify overload or underload, we need to be able to measure an operator s workload (WL). Unfortunately, workload is a subjective measure: it measures the subjective, experienced cognitive demand during a task. Assessing an operator s and particularly an ATCO s workload has been a longstanding research topic, and researchers have reverted to controller self-assessment using numeric scales. These methods suffer from various drawbacks (the query is intrusive, social bias may impact the self-assessment, and small WL variations cannot be recorded). Hence, in this project, we aim to make progress towards the development of objective, non-intrusive WL measures: we plan a study design with which we aim to reduce the impact of the numeric scales for WL assessment, we will record various promising WL-indicator candidates (e.g., eye-gaze measures) and then analyze the validity of these objective indicators.

Publications:

A. Lemetti, L. Meyer, M. Peukert, T. Polishchuk, C. Schmidt. Discrete-Fourier-Transform-Based Evaluation of Physiological Measures as Workload Indicators. DASC 2023, Barcelona, Spain. Paper.

A. Lemetti, L. Meyer, M. Peukert, T. Polishchuk, C.Schmidt, H. Alpfjord Wylde. Predicting Air Traffic Controller Workload using Machine Learning with a Reduced Set of Eye-Tracking Features. EAAP 2024. Paper, Slides.

A. Lemetti, L. Meyer, M. Peukert, T. Polishchuk, C.Schmidt, H. Alpfjord Wylde. Eye in the Sky: Predicting Air Traffic Controller Workload through Eye-tracking based Machine Learning. DASC 2024. Paper, Slides, Poster.

Navigationsstöd från land II (Navigation Support from Land II)

2022-2025

A set of simulation and on-site validation activities are planned for evaluation of the new paradigm where pilots are equipped to stay ashore (instead of bearding the boats) at some land-based center and guide the vessels in and out of the port remotely. In order to reach the full potential of the Navigation support from land concept from the economical and social point of view, we will propose to organize such on-shore pilots into a remote pilot station which could serve many ports simultaneously. We will provide our expertise on the methods of evaluation of the controllers' workload from the ATM, comparing VTS and ATC taking into consideration such important parameters as the background and cultural differences, the size of the surveillance area, the amount and precision of the information provided by the controllers, vehicle speeds and training procedures. AEAR group is participating as a partner in this project led by Sjöfartsverket (SFV), conducted in collaboration with Rise, LFV, Chalmers University and SSPA.