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Air Traffic Management and Noise

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1 Introduction

One part of ICAO's so called balanced approach for noise reduction from aircrafts focuses on operational procedures or air traffic management. In order to exploit these possibilities and motivated by problems in particular at Swedens largest airport, a new Centre for Sustainable Aviation has been created at KTH-The Royal Institute of Technology (www.kth.se/en/sci/centra/hallbarluftfart). The centre is set up as a co-operation with the Swedish Transport Organisation for a period of 10 years, under which a total 50 MSEK will be spent on research with the purpose to create solutions for air traffic management that includes environmental impacts in particular noise. This means to develop new or better tools and procedures allowing flight paths close to airports to be optimized to minimize the environmental impact. For instance by creating noise maps based on current weather conditions to minimize noise exposure. The purpose of this paper is to present a brief summary of the current research in the centre.

2 Projects in the centre

- **SAFT** A project with the objective to create improved physics based tools for simulating noise from aircraft take-offs and landings.
- **BRANTARE** A project with the objective to study flight operations including approach angle and how handling the aircraft on approach and landing may affect noise imission to the ground.
- **ULLA** measurements of aircraft noise at take-offs and landings to validate SAFT (= source and transmission models) and test sound quality metrics.
- **INFRA** A project which will study AVIATION as an infra structural system to understand how the involved stakeholders handles external changes e.g. stricter noise regulations.

The four projects above run for 2-4 years and started 2017. The projects are linked exchanging results in order to create a joint output with as large as possible benefit for the centre stakeholders. Below a short presentation of the projects are given.

2.1 SAFT - Simulation of Atmosphere and air traffic For a quieter environmenT

The research project SAFT aims at the development of a computation and simulation tool for aircraft noise. The tool is intended to take into account all the elements in an aircraft type/engine and the operation of it, along with the atmospheric conditions (weather) at the time for the flight, which effects the resulting noise on ground [1]. SAFT may, as yet, be seen as a complement to the so-called "Integrated tools/methods", like INM [2] and ECAC Doc.29 [3] , and as such a complement that goes beyond the capabilities of those. The integrated methods are, despite their well-known limitations such as dissolving effects of individual variations in flight operations and aircraft/engine design, able to fulfill their purpose to visualize and quantify noise exposure from an operational activity over longer periods of time (1 year) and to identify trends. If the focus of planned studies instead are on noise effects of new approach and take-off procedures, new or modified aircraft engines or configurations, special or typical weather situations, the integrated methods have serious limitations. In these situations, one need to decouple the noise sources from the sound propagation, as well as separate the different noise sources (such as "jet noise", "fan noise" and "landing gear" etc.). Furthermore, one needs to resolve the frequency content, both in order to carry out the sound propagation accurate enough, but also to assess the degree of disturbance when the sound reaches receivers on the ground. The described type of studies could though be possible with the SAFT tool. SAFT could further on, also be used for "noise forecasts" like today's weather forecasts, or for noise calculations in "almost" real time, partly based on atmospheric data recorded by the aircraft themselves. Studies of the mentioned types could in turn be part of noise mitigation studies, studies related to construction of new runways (including a partly replaced aircraft fleet), building of new residential areas in the vicinity of airports etc. Moreover, by establishing a "physics based" simulation platform like SAFT we also aim to support Swedish aircraft noise research in the long term by providing a framework in which successful research in the field and newly developed techniques can be implemented and utilized.

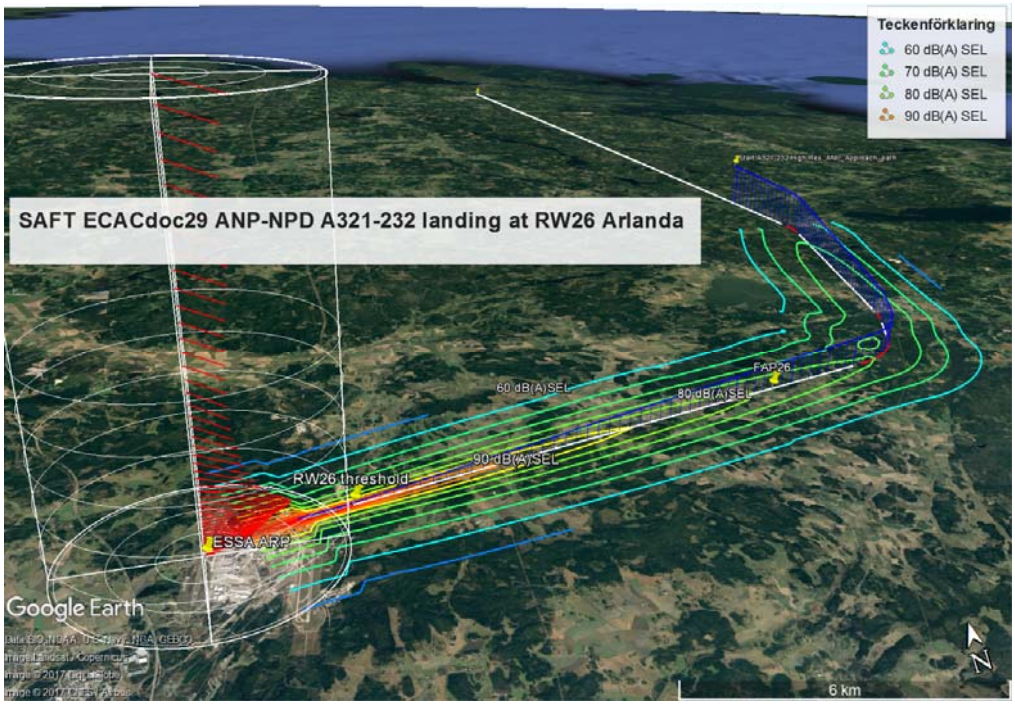

Figure 1: Noise map example for normal landing procedure at Arlanda airport based on existing models.

2.2 BRANTARE

A steeper approach path is one potential way to reduce the perceived aircraft noise level on the ground around airports. However, pilots' changed operating behaviour on a steeper glide slope may have an impact, or even a counterbalancing effect on the desired noise reduction outcome. The overall aim of this research is to estimate pilot impact on the noise abatement in steeper approaches. Actual recorded winds during standard 3.0 degree glide slope angle approaches will be used to develop an equivalent zero wind glide path angle. Correlations of glide slope angle and pilot operational behaviour will be analyzed. In a pre-study [4], the logic behind the development of an equivalent zero wind calculation method is presented. A user-centered approach was applied which included a pilot workshop, and interviews with airline pilots. Based on the results it was decided to use the average wind from glide slope intercept to landing gear extension for the analysis of the pilots' behaviour. The equivalent zero wind calculation method selected will subsequently be applied to analyze pilot impact on noise abatement at various glide path angles. This will increase the knowledge about how to minimize the actual noise footprint around airports considering varying glide slope angles and meteorological conditions. The results will also be validated by using the simulation tool developed in the project SAFT.

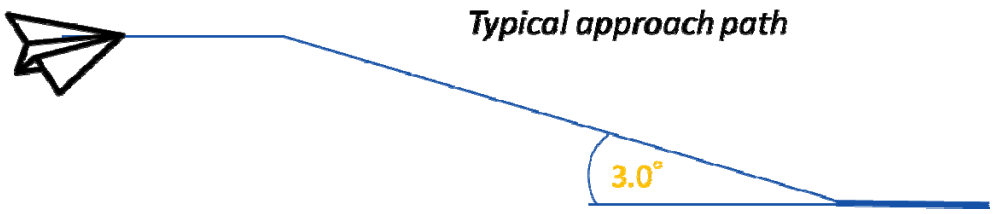

Figure 2: BRANTARE is based on the assumption that: An approach conducted in tailwind conditions "equals" a steeper approach angle under 0-wind conditions.

2.3 ULLA

The project ULLA stands for "Survey based on noise measurements for landings at Arlanda" and aims to measure the aircraft sound around the airport's approach routes to explore whether different meteorological conditions and air operational handling of aircraft can reduce noise nuisance at the landings. On a number of measurement sites, long-term measurements will be carried out in order to obtain a comprehensive picture of the sound levels around the airport and how these depend on flight paths, meteorology and sound propagation. The measurement results will be analyzed along with meteorological data and airline operational data and using the software tool developed in the project SAFT. This analysis is done to investigate possible links between the landing operations, meteorological conditions and sound. The measurements will focus on positions at a distance to the airport's runways, which correspond to the areas disturbed by noise from landing operations such as Upplands Väsby and Rosersberg. The project connects thereby directly to the centre core areas, air traffic control, flight paths and sound propagation. In addition to noise measurements and analysis the plan is to use complete recordings of landing sounds for listening tests.

2.4 INFRA

The air transportation system (ATS) strives to increase capacity and at the same time reduce environmental impact and increase safety. Commonly the environmental impact is referred to as CO2, but another environmental aspect is noise. Noise is a negative bi-product. KTH Centre for Sustainable Aviation (CSA) has been established with the

aim and purpose to reduce noise from aviation in collaboration with all the main stakeholders of the ATS. And partners all agree that something will have to change in aviation.

The purpose is to investigate factors in the INFRA system, analyzed as a socio-technical system, that can contribute towards system change to reduce noise from aviation and to identify which system stakeholders that can contribute in this process. The aim of the research project is to contribute in the understanding of how system externalities, such as noise, can be internalized and become an integrated system component.

3 Summary

For more information about the projects above and the center please go to:
www.kth.se/sci/centra/hallbarluftfart/invigning

References

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