OPNOP
Operational Noise Optimization

Is it possible to move noise from one area to another by operational recommendations or limitations?

**Optimization** noun
op-ti-mi-za-tion  
[ˈɒp-tə-mə-ˈza-ʃən]

Definition of optimization
an act, process, or methodology of making something as fully perfect, functional, or effective as possible
OPNOP – Research questions

• Is it feasible to protect noise sensitive areas on the ground by operational recommendations to pilots?

• Is it reasonable to believe that operational recommendations can take actual weather into consideration?
OPNOP – Pre-requisites

• Noise from landing aircraft is generated by the engines and by the airframe

• Engines can be in idle or up to maximum thrust

• The engine noise is dependent on rpm

• The airframe consists of fuselage, control surfaces, landing gear and a lot of small devices

• The airframe noise is airspeed dependent

• Hence! Noise is dependent on how the engines are operated and how the airframe is configured
Brantare - Ops. variation - Flaps

Flap 1 selected

Flap 2 selected
Brantare - Ops. variation - Gear

Landing gear selected down

Distance to threshold [m]

Height over threshold [ft]
Brantare - Ops. variation - Flaps

Landing Flap selected

Distance to threshold [m]

Height over threshold [ft]

30 000 25 000 20 000 15 000 10 000 5 000 0

0 500 1 000 1 500 2 000 2 500 3 000 3 500 4
Brantare - Ops. variation - Airspeed
Variation in Airspeed

Picture from the ULLA project showing variation in airspeed and noise
Brantare – Tailwind dependency

Flap 1

\[ y = 41.1x + 11 \quad 200 \]
\[ r = 0.03 \]
\[ p = 0.68 \]

Gear

Flap 2

\[ y = 28.7x + 1 \quad 040 \]
\[ r = 0.02 \]
\[ p = 0.75 \]

Flap 3

\[ y = 504x - 200 \]
\[ r = 0.17 \]
\[ p = 0.02 \]
Weather dependency – Noise propagation

Atmospheric data

AROME prognoses model
- 65 vertical levels, 2.5x2.5 km horizontal resolution
- 47x54 = 2538 horizontal gridpoints
- 4319 snapshots of Pressure \( p \)
- Temperature \( T \)
- Relative humidity \( \mu \)
- Wind velocity east \( u \)
- Wind velocity north \( v \)
at two-hour intervals throughout year 2017

*Nuber, et.al., ‘AROME MetCoOp: A Nordic Convective-Scale Operational Weather Prediction Model’, https://doi.org/10.17651/M-06039.1

Pictures by Ilka Karasalo and Ulf Tengzelius (SAFT-project)
CSA – Collaboration & Info Sharing

ULLA

INFRA

Brantare

SAFT
CSA – Collaboration & Info Sharing

- ULLA
- INFRA
- ERAS
- TREVOL
- CIDER
- ODESTA
- OPNOP
OPNOP – Research questions

• Is it feasible to protect noise sensitive areas on the ground by operational recommendations to pilots?

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OPNOP – Method

• Collect FDR-data from Novair’s aircraft
• Collect weather data for the same flights
• Collect noise data from the flights in co-op. with ULLA
• Send data to ULLA, CIDER, TREVOL, ODESTA and ERAS for use in their projects
• Analyze noise and compare with flight operational events
• Develop new operational scenarios for minimum noise
• Evaluate new scenarios with software from the SAFT-project (noise) and software from Airbus (Fuel and CO₂)
Questions on OPNOP?
ERAS - Evaluation of Realistic Approach Scenarios

How well do theoretical noise calculations correlate to aircrafts’ standard operating procedures and the way the aircraft are actually operated?
• When noise is calculated in Sweden, the document “Kvalitetssäkring av flygbullerberäkningar” is the governing document

• But it points to ECAC Doc 29...

• ...and in Europe the Aircraft Noise and Performance database (maintained by Eurocontrol) is the basis for the calculations
ERAS

• Aircraft performance, operations and noise levels are described in the ANP-database

• But aircraft operations is also described in every aircraft’s SOP.

• And the there’s the real life...
Approx. extension behavior SOP

3.0° glideslope  Extension behavior
Extension behavior acc. to ANP

- 3.0° glideslope
- Extension behavior
Brantare - Ops. variation - Airspeed

Yellow dots acc. to ANP database
ERAS - method

• Select 10 relevant aircraft types
• Evaluate ANP, SOP and real life procedures
• Create realistic approach scenarios in order to minimize noise but still manageable by ATC (co-ordinate with ODESTA)
• Verify in flight simulators
CSA – Collaboration & Info Sharing
Questions?