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Applying machine learning to aircraft noise modelling

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by Robert Koster, Founder and CEO

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Our History

- Founded in 2017 at TU Delft's Aerospace Innovation Hub
- Launch Product Echo API
- Worked with Airports, Governments and Consultants
- A leading national expert on Airport Noise and ECAC Doc 29

Our Philosophy

"We are passionate about solving real life problems with digital solutions and we believe combining computer science with aerospace engineering creates new opportunities to advance the aviation industry "

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Our view on AI and machine learning

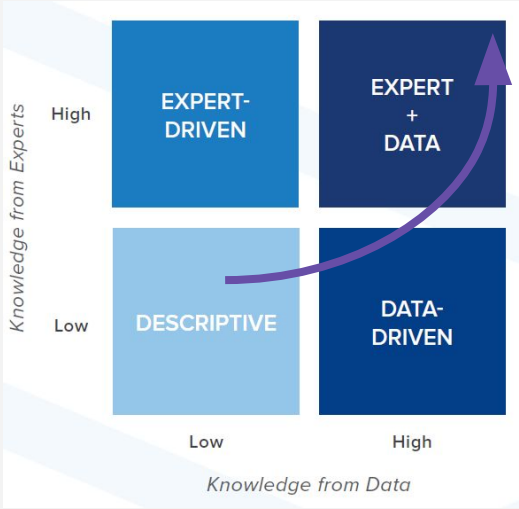
Predicting the future is hard, but predicting something that happens regularly is easier than a unique event

Think of adverse weather conditions vs. COVID-19

Expert-driven vs. data-driven

Traditionally, experts make the predictions at the airport based on information and experience. Providing models the same information and historical data can lead to the same results.

We combine the expert- and data-driven approach



Expert-driven vs. data-driven approach (from The Ten Levels of Analytics)

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How we use AI and machine learning in aircraft noise

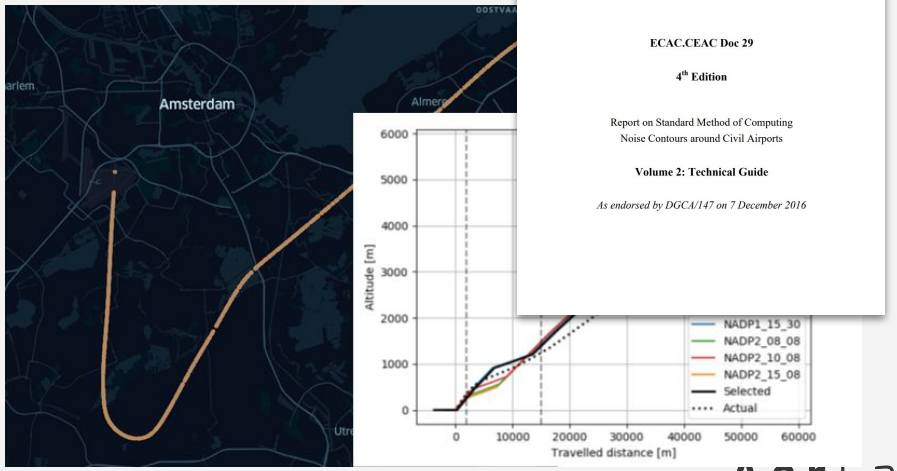
When using a standardised aircraft noise model, it's all about pre-processing and post-processing of the data

Input data:

- trajectories
- flight performance
- traffic scenarios

Output data:

- aircraft noise levels
- aircraft noise contours



EUROPEAN CIVIL AVIATION CONFERENCE

CONFERENCE EUROPEENNE DE L'AVIATION CIVILE

SECRETARIAT

ECAC.CEAC Doc 29

4th Edition

Report on Standard Method of Computing Noise Contours around Civil Airports

Volume 2: Technical Guide

As endorsed by DGCA/147 on 7 December 2016

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A use case: Predicting trajectories

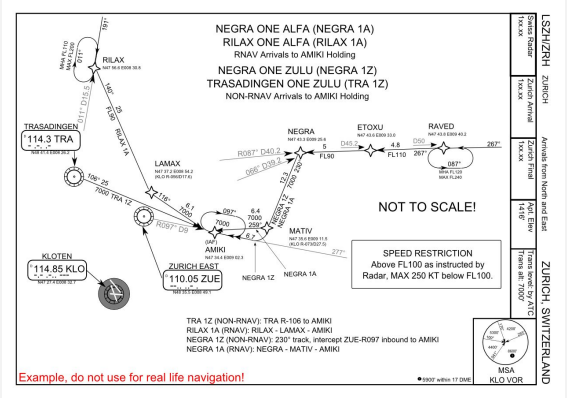
Trajectories are a very important part of the aircraft noise assessment

Two types of trajectory data:

- Theoretical data
- Historical data

Depending on the type of aircraft noise assessment, the appropriate data can be selected.

Example of STAR (from Wikimedia)



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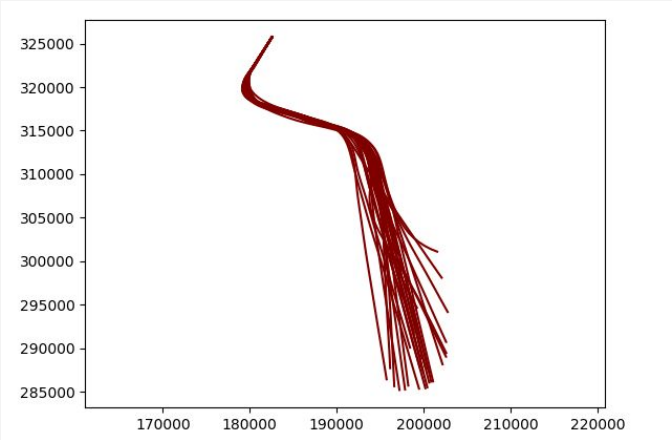
A use case: Predicting trajectories

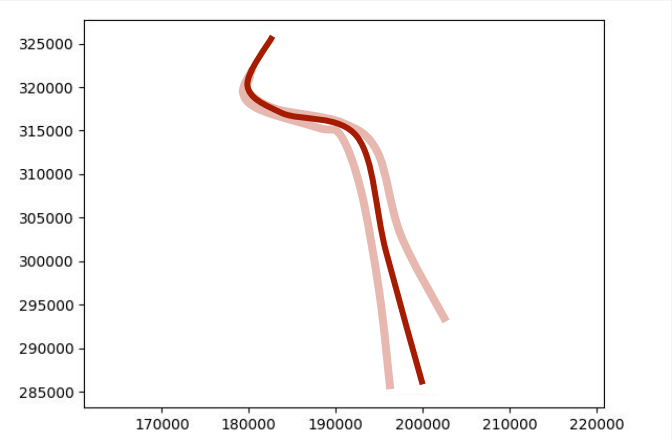
Problem:

How to predict trajectories based on historical data?

Example of trajectories in 2018

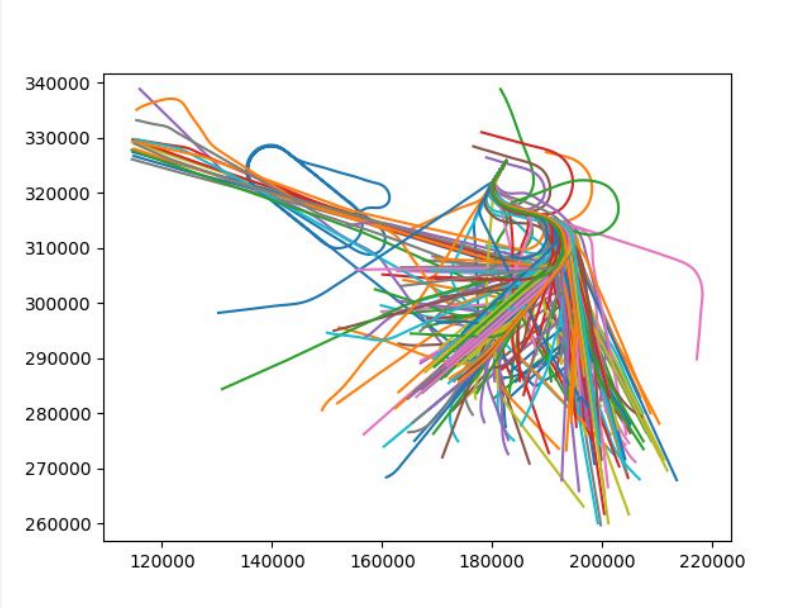


Prediction of trajectories in 2019

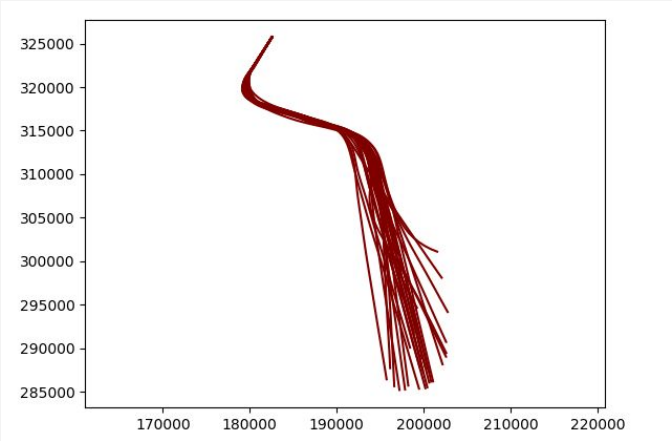


A use case: Predicting trajectories

Example of all trajectories (1 year) of a single aircraft type, for a single SID



Example of trajectories in 2018



A use case: Predicting trajectories

Goal:

To craft theoretical routes based on historical data, optimized for best-possible noise level fit, using machine learning techniques.

Advantages:

- Quick
- Not labor intensive
- Reproducible

A use case: Predicting trajectories

Approach:

- Determine the scoring method
- Construct method to create a backbone track for a group of similar tracks
- Create method to create groups of similar tracks
- Optimise the number of groups to match the criteria

Desired result:

A set of theoretical tracks (backbone track with dispersion) that describes the flights around the airport

A use case: Predicting trajectories

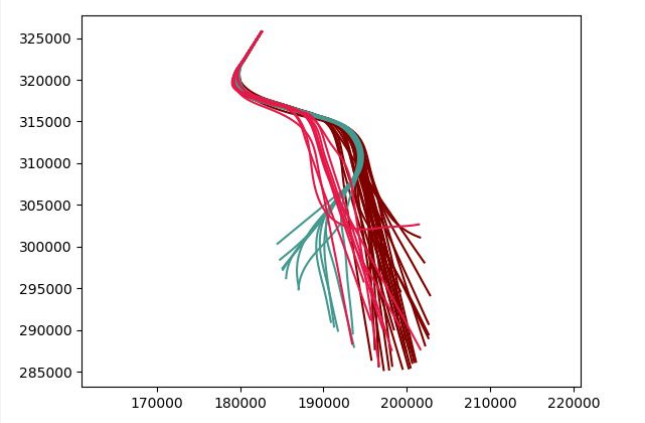
Creating groups of similar tracks

A group has 1 main “backbone” track with dispersion.

Needed a clustering method to create these groups.

- Using dimensionality reduction, and
- A HDBSCAN algorithm

Example: 3 groups of similar tracks



HDBSCAN vs. KMeans (from hdbscan.readthedocs.io)

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How we use AI and machine learning in other areas

Applied AI and machine learning techniques in other areas too:

- Predict uncertainty of weather forecasts
- Predict arrival times using neural networks
- Deduplicate messages
- Runway capacity prediction (Digital Sky Challenge 2019)

How we will be using AI and machine learning in the future

Route (re)design tool:

A web application to quickly assess the noise impact of changes to routes and procedures.

- Can be used by aircraft noise professionals and the general public.
- Still using European best-practices for aircraft noise modelling.
- Especially with general public, we need to simplify the modelling
- Machine learning will be used to further simplify the aircraft noise assessment, such as creating input traffics, fleet compositions, ground track dispersion, etc.

Thank you!

Visit us at www.aerlabs.com

Questions about this slide deck?

Contact Robert Koster via robert@aerlabs.com