Data Process - Modelling - Conventions / Methods

This paper summarises the data preparatory action and methods developed for the paper.

Trajectory

We tap into OSN data. A trajectory is a series of time-ordered 4D positions, i.e., TIME, LAT, LON, ALT, associated with a FLTID, and some complementary data (e.g. first derivates, special codes)

Single Flight: Represent each trajectory as a 4D function

$$flight_i \rightarrow T_i(t)$$

$$T_i(t) = (x_i(t), y_i(t), z_i(t), t), t \in \left[t_{starti}, t_{end_i}\right]$$

A **trajectory set** comprises multiple flights, a collection of multiple trajectories

$$\{T_1(t), T_2(t), ..., T_N(t)\}$$

Arrival Flights - Characteristic Milestones

An arrival flights is defined by the path flowm from *entry of arrival airspace* to *touchdown* at the landing runway.
Dependent on the data coverage, open ADSB data might not be available until touchdown. For this purpose, we can define a *(landing) gate* position located about 6NM before landing runway.

Conceptually, we consider a milestone the 4D position of a flight event. Thus, milestones are implicitly representing timestamped flight events (e.g. actual time of landing [ALDT]).

- **entry of arrival airspace**: conceptually the first entry into the arrival airspace; for this study we define the entry at 200NM from the landing aerodrome, i.e., its aerodrome reference point (ARP)
- **top of descent (TOD)**: a point in space from which the descent to the airport for landing is started
- **landing gate**: a point at 6NM before the landing runway threshold; arrival procedures typically foresee a final approach fix etc.; we generalise this to be at 6NM - the actual values at different airports may vary for different arrival procedures. At this point in time the arriving flight is considered in sequence for the landing.
- **touchdown / actual time of landing (ALDT)**: the landing performed by the flight; dependent on data coverage this event may be detected (or needs to be estimated based on previous positions / landing profile). It must be noted that aircraft cross the end of the runway / threshold at a specific safety altitude. For example, the ground point of intercept of an ILS approach is typically located 800-1000ft after the landing threshold.
  Note: we may approximate the ALDT as the time of (spatially) crossing the threshold.

Data Prep

```
# laod basic stuff
library(ggplot2)
ggplot2::theme_set(ggplot2::theme_minimal())

devtools::load_all()  # load my functions, i.e. zip utils
```

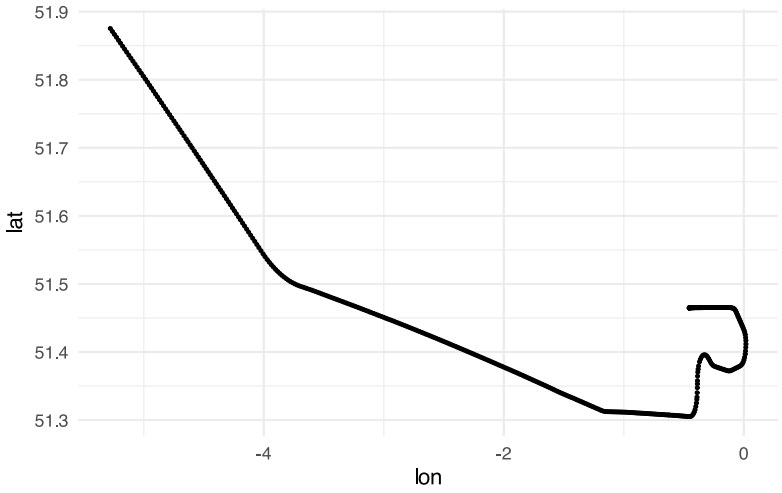
```
ℹ Loading paper-2025-DASC-arrivalmgt
```

```
# get some test / development data
pth_to_data       <-  here::here(here::here()  |>  dirname(),  "__DATA",  "OSN-
DASC2025-200NM")
data_fn_names  <- check_zip_content(pth_to_data,"dasc2025-opdi-dump.zip")$Name

eddf_test_fn  <- "data/*-to-EDDF/tracks_adep_*_ades_EDDF_2024-06-30.parquet"
egll_test_fn  <- "data/*-to-EGLL/tracks_adep_*_ades_EGLL_2024-06-30.parquet"

egll_trjs        <-  read_zip(pth_to_data,  "dasc2025-opdi-dump.zip",  .files  =
egll_test_fn)
eddf_trjs        <-  read_zip(pth_to_data,  "dasc2025-opdi-dump.zip",  .files  =
eddf_test_fn)
```

```
tst_trjs <- egll_trjs |>
  dplyr::filter(track_id %in% c(
    "c65aa5dcce090b7cc2c176491cbb2c8906fa0641a006397a98824dbc7ed2d92f_4_2024_6"
  ))


library(sf)
```

```
Linking to GEOS 3.11.0, GDAL 3.5.3, PROJ 9.1.0; sf_use_s2() is TRUE
```

```
tst_trjs |>
  ggplot() + geom_point(aes(x = lon, y = lat), size = 0.5)
```


51.9
51.8
51.7
51.6
51.5
51.4
51.3
lat
-4
-2
0
lon