Dataset Format

Full-size images:

Images are saved as PNG files. The naming convention is as follows:

{AIRPORT ID}_{RUNWAY NUMBER}_{TIME PERIOD}_{WEATHER}_{EPISODE NUMBER}_{IMAGE NUMBER}.png

- Airport ID: airport identification code
- Runway number: runway number
- Time period: time of day
    - morning (5am - noon)
    - afternoon (noon - 5pm)
    - night (5pm - 5am)
- Weather: cloud conditions
    - clear
    - cirrus
    - scattered
    - broken
    - overcast
- Episode number: episode for particular run
- Image number: image index within episode

All other data is saved in a CSV file called labels.csv. The columns are outlined below:

- **image_filename:** file name of the corresponding image
- **absolute_time_GMT_seconds:** absolute GMT time in seconds
- **relative_time_seconds:** time in seconds relative to the start of the episode
- **distance_to_centerline_meters:** crosstrack error in meters
- **distance_to_centerline_NORMALIZED:** crosstrack error / 10.0
- **downtrack_position_meters:** current distance down the runway in meters
- **downtrack_position_NORMALIZED:** downtrack position / 2982.0
- **heading_error_degrees:** heading error relative to facing straight down the runway in degrees
- **heading_error_NORMALIZED:** heading error / 30.0
- **period_of_day:** time of day
    - morning (5am - noon): 0
    - afternoon (noon - 5pm): 1
    - night (5pm - 5am): 2
- **cloud_type:** measure of cloud cover (higher numbers are cloudier/darker)
    - clear: 0
    - cirrus: 1
    - scattered: 2

- broken: 3
- overcast: 4

Downsampled images:

We also provide downsampled versions of these datasets, which are used for training small networks so that formal verification is tractable. The images have been cropped, converted to grayscale, downsampled to increase the brightness of the runway markings, and biased so that all pixels have an average value of 0.5. For information on the downsampling, see section IV.A of this paper. The downsampled datasets are stored in hdf5 files under the variables “X_train” and “Y_train” (similary “X_val” and “Y_val” for the validation set and “X_test” and “Y_test” for the test set). The “X_train” variable is 16 x 8 x num_images and contains the downsampled images. The “Y_train” variable is 3 x num_images and the rows contain the crosstrack errors, heading errors, and downtrack positions respectively.

A note on the data generation:

The datasets represent a series of simulated sinusoidal trajectories down the runway. The trajectories differ in their rudder input, angle limit (max heading error before turning back to the center), and center crosstrack error. The trajectories are split into train, validation, and test sets as follows:

Train:

- 7 trajectories with angle limit of 5 degrees, rudder input of 0.05, and center crosstrack spaced evenly between -8 and 8 meters
- 3 trajectories with angle limit of 10 degrees, rudder input of 0.05, and center crosstrack errors of -6, -2, and 2 meters
- 4 trajectories with angle limit of 10 degrees, rudder input of 0.2, center crosstrack errors space evenly between -6 and 6 meters
- 3 trajectories with angle limit of 20 degrees, rudder input of 0.1, 0.2, and 0.3, and a center crosstrack error of 0 meters
- 2 trajectories with an angle limit of 25 degrees, rudder input of 0.25 and 0.35, and a center crosstrack error of 0 meters

Validation:

- 3 trajectories with an angle limit of 20, rudder inputs of 0.08, 0.18, and 0.28, and a center crosstrack error of 0 meters
- 2 trajectories with an angle limit of 25, rudder inputs of 0.23 and 0.33, and a center crosstrack error of 0 meters

Test:

- 3 trajectories with an angle limit of 10, a rudder input of 0.1, and center crosstrack errors of -3, 0, and 3 meters

Because these are different trajectories, the train/val/test distributions will not match exactly. We did this to keep the trajectories intact. We suggest combining all of the data and randomly resplitting into train/val/test sets if this is a concern.