Harmonic Radar: Drone Trial 2022-06-09

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1 Objective

The objective of this trial was was to map the location of a single harmonic radar target placed beneath a linear transect flown by a drone.

2 Methods

A RECCO hand-held harmonic radar transceiver was suspended with rope about 1.5 feet beneath the landing struts of a DJI AGRIS MG-1 drone. A target consisting of 2 harmonic radar tags with antennae placed at right angles (Figure 1) was positioned in an open field and the drone was programmed to fly along a line which crossed this position.

Figure 1: Target.

2.1 Harmonic radar recording

The RECCO hand-held harmonic radar device generates an audio signal to indicate that a reflection from a harmonic radar tag has been detected. The amplitude of this signal is maximum when the receiving antennae points at the target and it increases as the target gets closer. A human operator locates the direction of a tag by directional scanning with the antenna while monitoring the signal using a built-in speaker or headphones. In this application, we point the receiving antenna straight down and record the signal by connecting a small digital audio field recorder (ZOOM F2) to the audio jack. The F2 records monophonic 32-bit floating point WAV files at a rate of 48,000 samples per second.

An Audacity screenshot displays the waveform and spectrogram of the record created during the trial (Figure 2). The WAV file was processed using a Jupyter notebook which performed the following steps.

- Noise reduction: Background noise was removed from the signal by the noisereduce Python library.

- Data reduction: The mean absolute amplitude (MAA) of the signal was calculated for each second within the WAV file. MAA is used as a measure of signal strength.

Figure 3

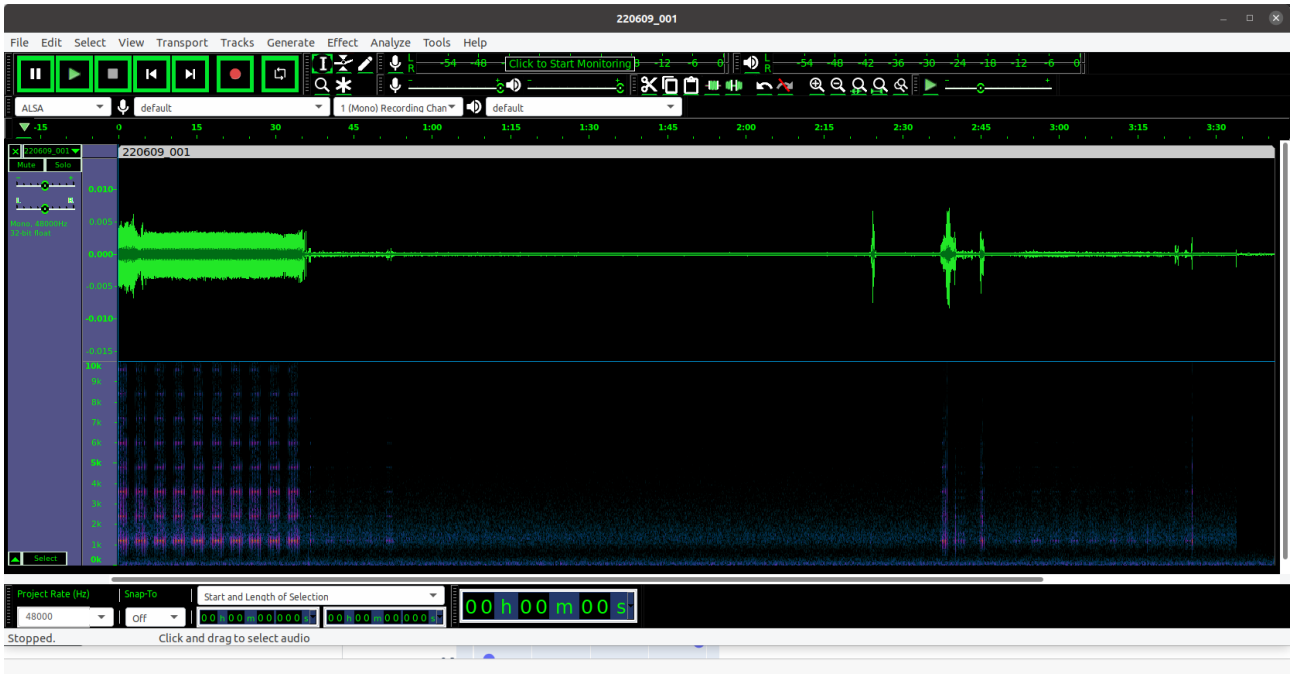

Figure 2: Audacity.

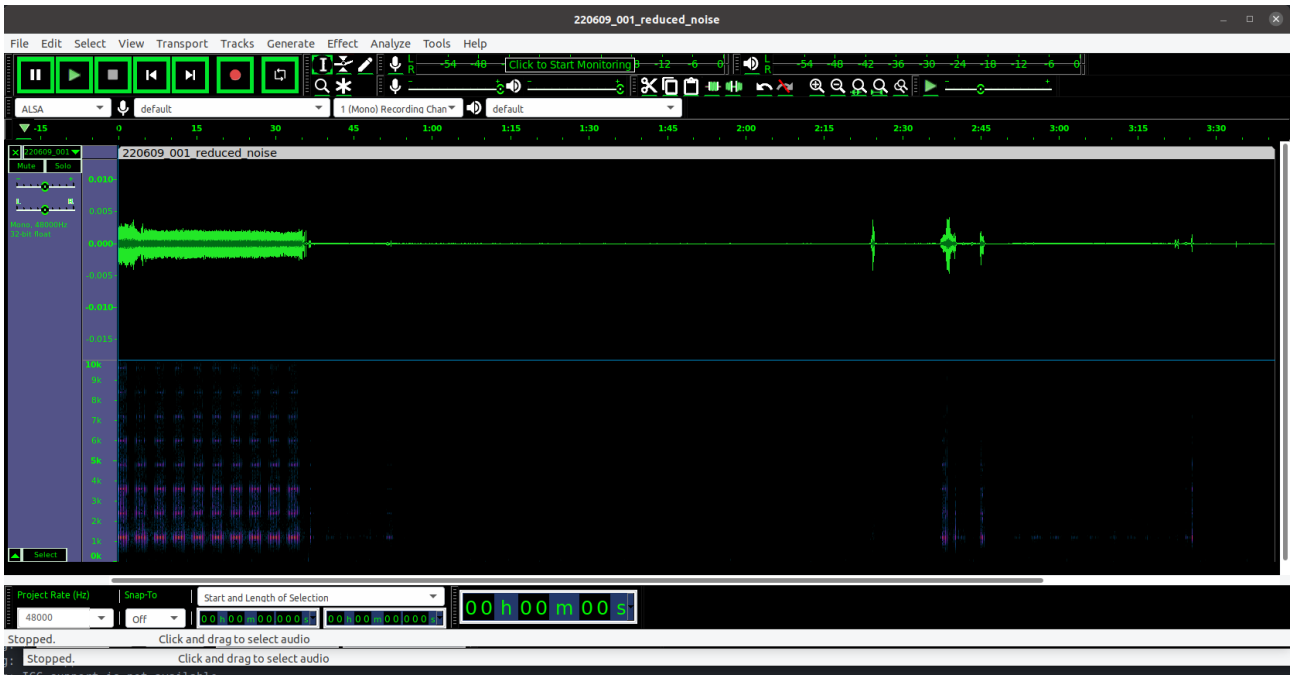

Figure 3: Audacity-noise-reduction.

2.2 GPS track recording

The flight data log was downloaded as FLY275.DAT from the drone. This file was parsed using a free Java program named DatCon using parameters recorded in Figure 5. DataCon creates three files:

- a CSV containing 1,275 columns. I set the sample rate to one row per second (1 Hz).
- a text file containing event messages.
- a KML file containing latitude and longitude of points along the drone's track **??**.

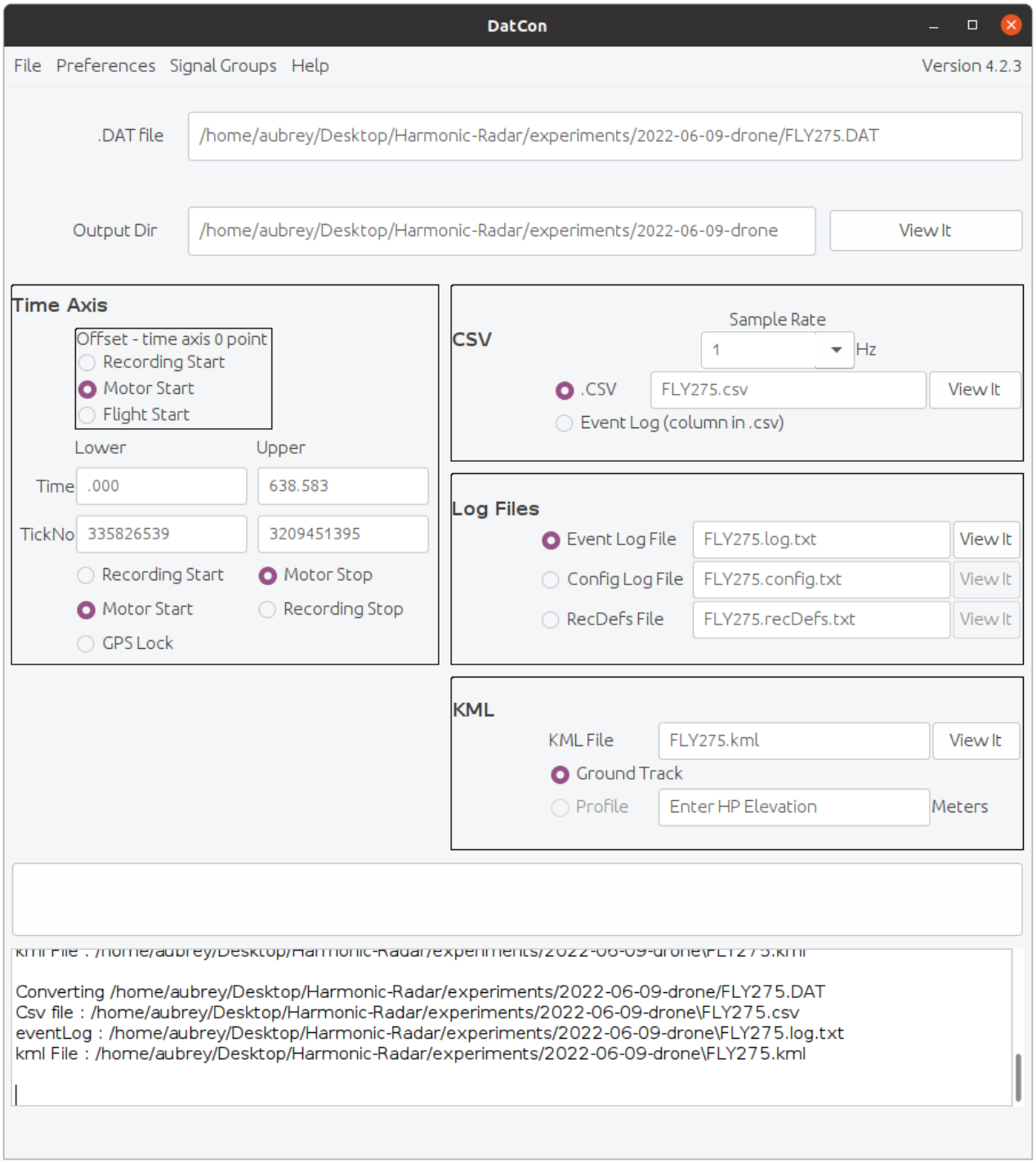

Figure 4: DataCon.

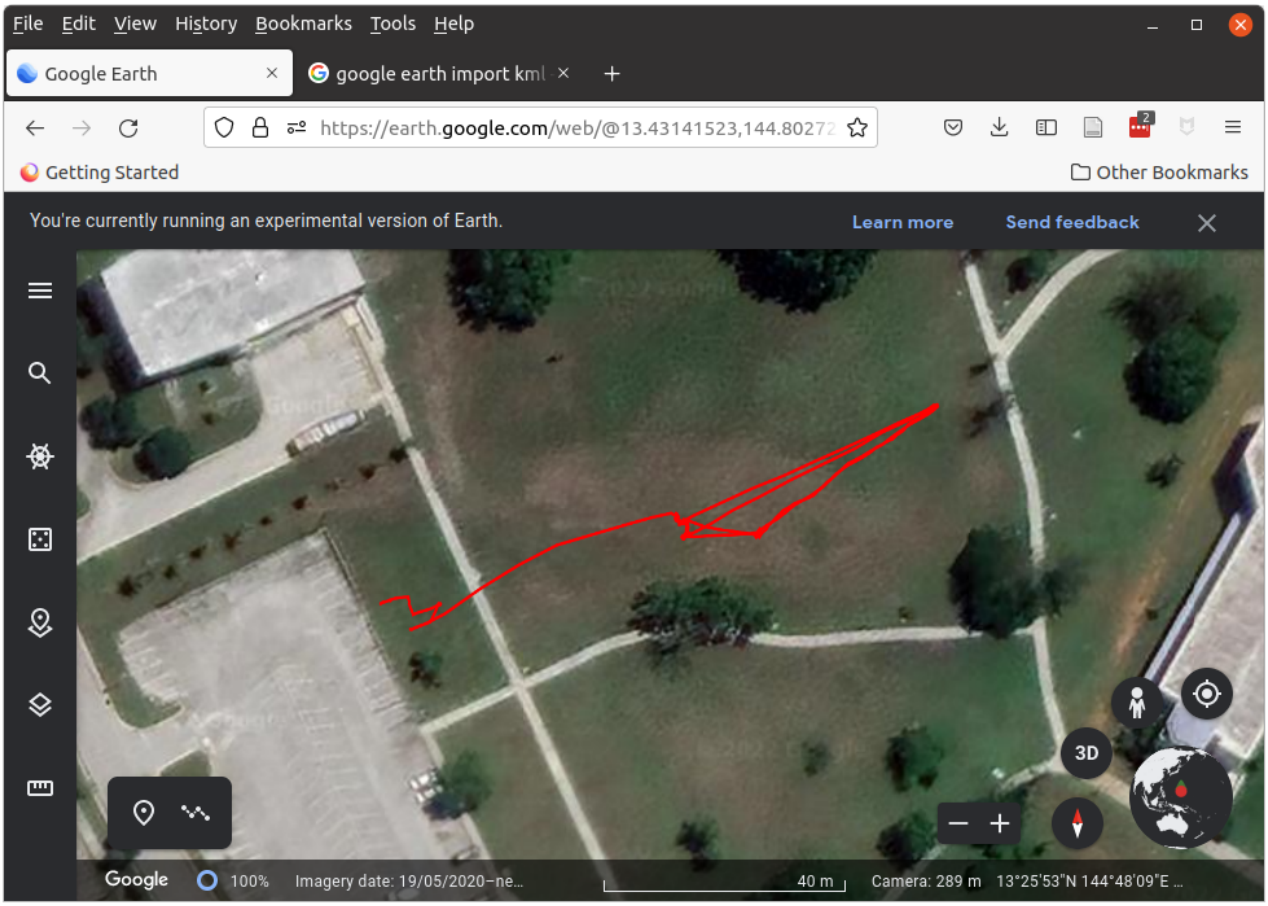

Figure 5: Google Earth.

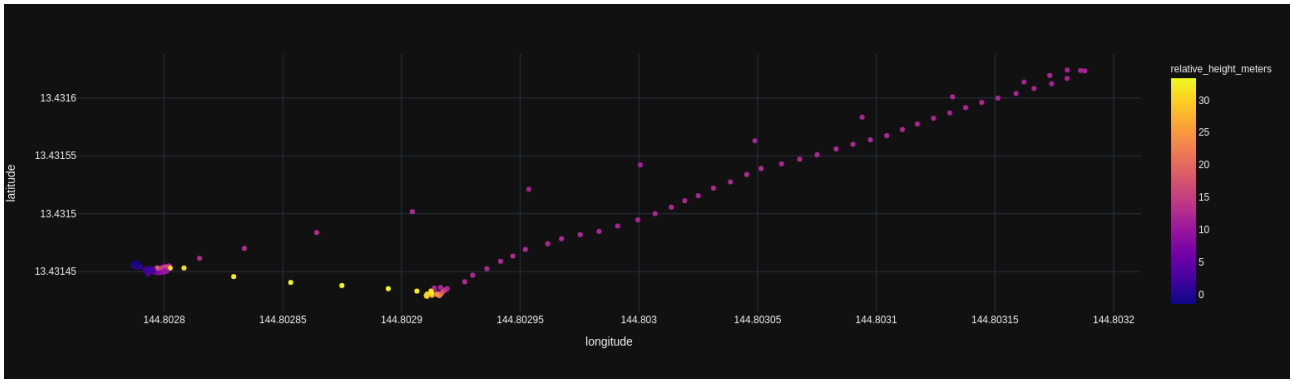

Figure 6: flightpath

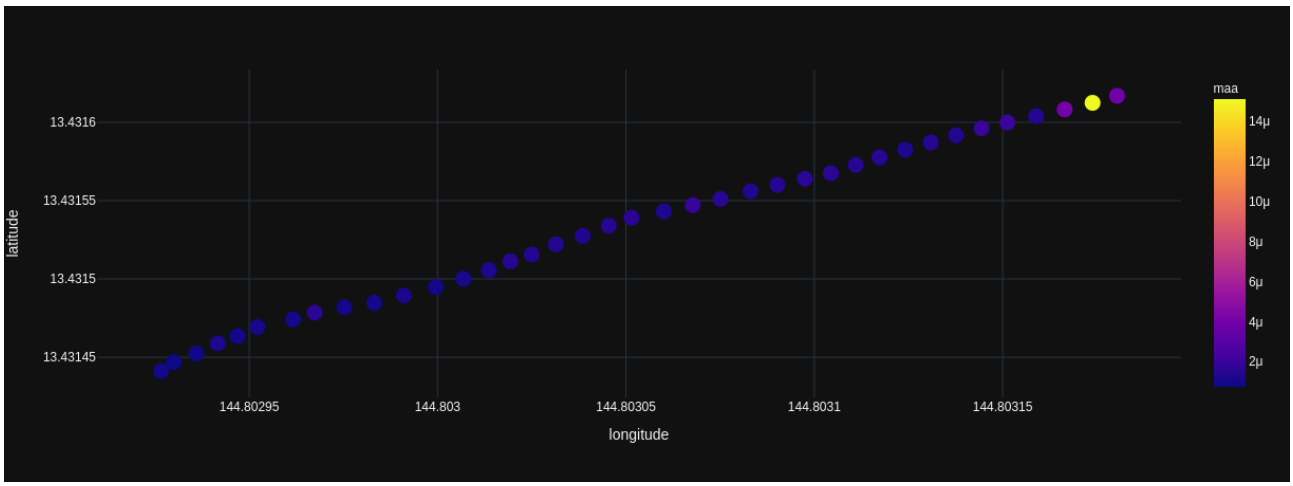

Figure 7: latlonmaah

3 Results and Discussion

3.1 Harmonic radar recording

3.2 GPS track recording