

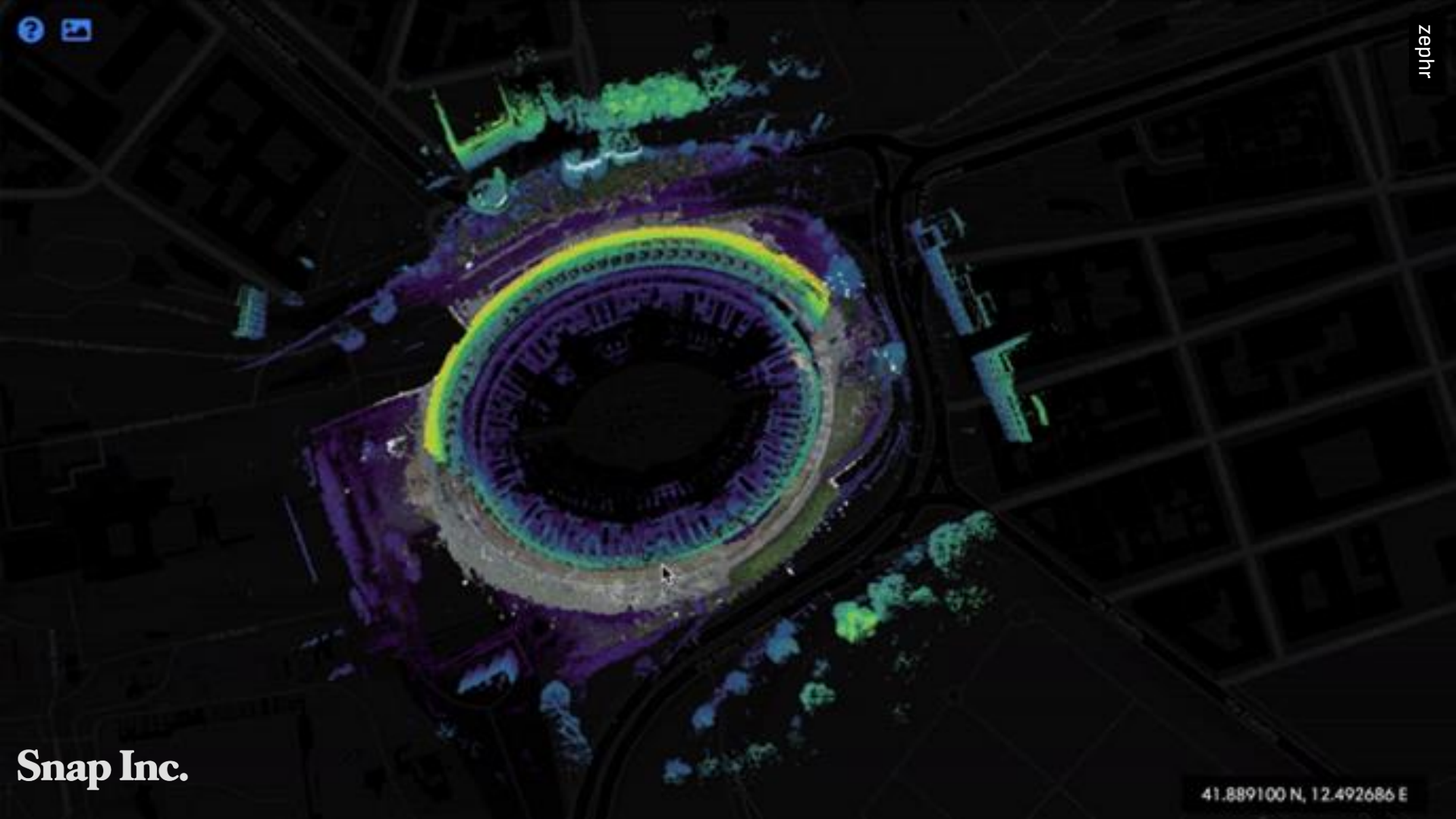
a TAK powered early warning
jamming/spoofing network

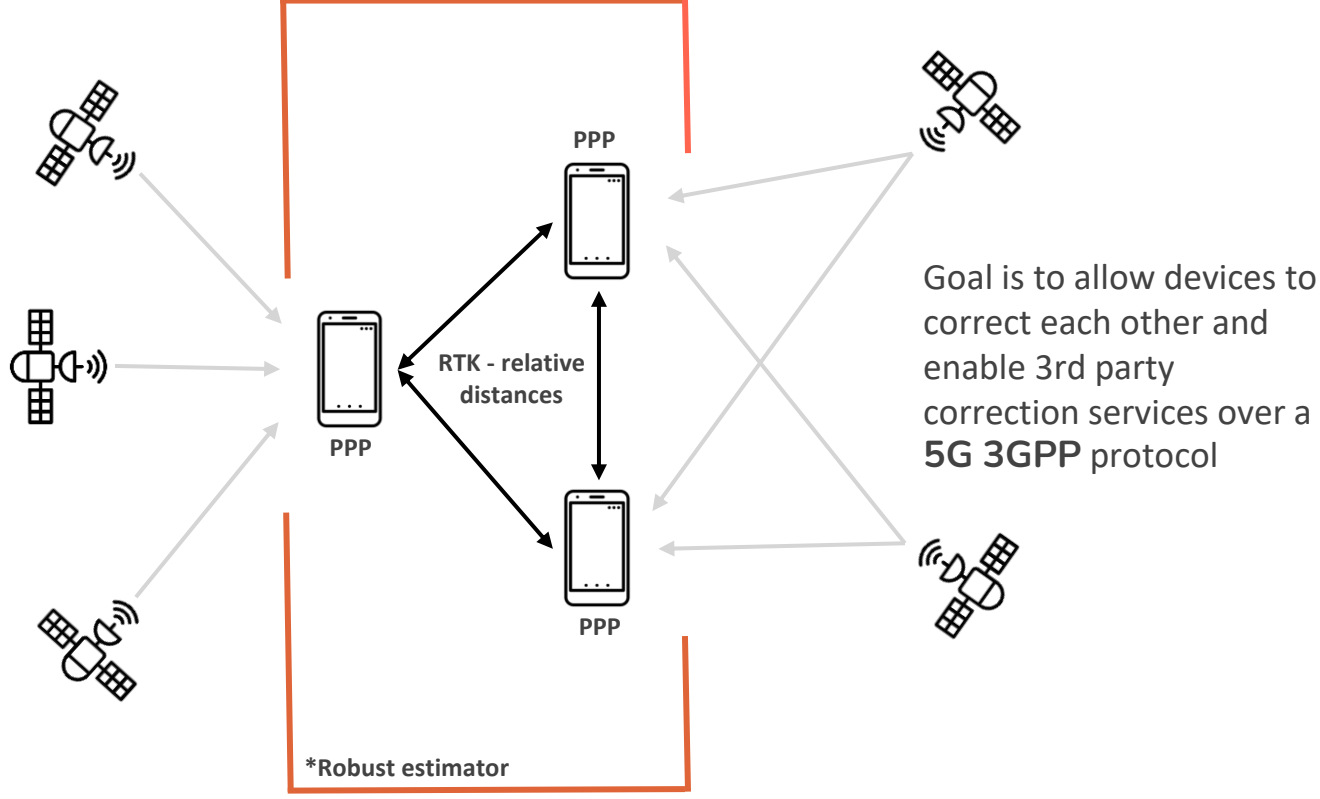
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cooperative positioning







УКРАЇНСЬКА ДОБРОВОЛЬЧА АРМІЯ

UKRAINIAN VOLUNTEER ARMY

SEPARATE SERVICE OF UAV

ukraine testing

GPS is increasingly under attack by foreign adversaries. There is no AltPNT “silver bullet”. How do we make GPS more resilient?

- ✗ Without an “initial known position” many AltPNT approaches struggle
- ✗ Next generation Russian jamming in Ukraine is invalidating many techniques
- ✗ We need a multilayered approach that provides robust fallbacks





DETECTION

We need to know when and where jamming or spoofing is happening



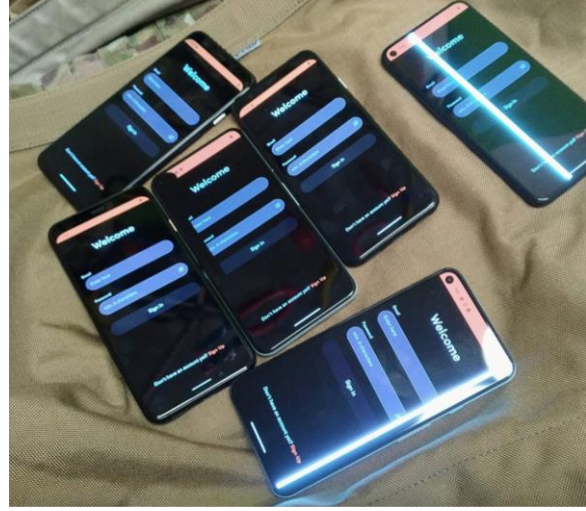
LOCALIZATION

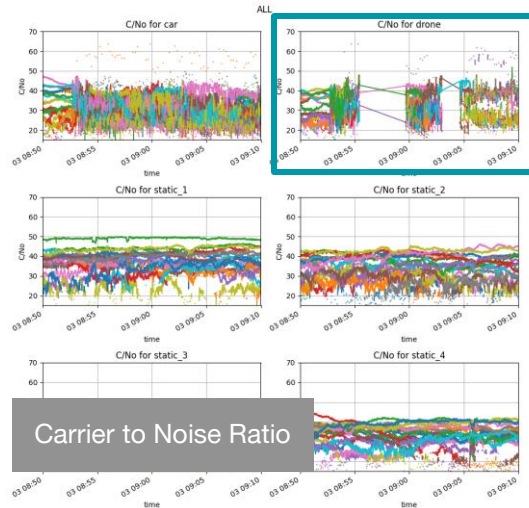
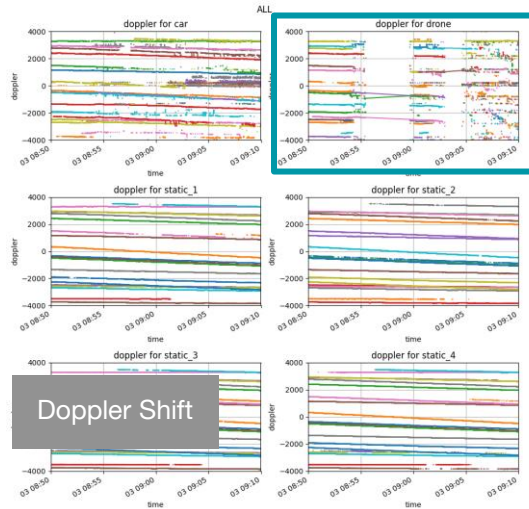
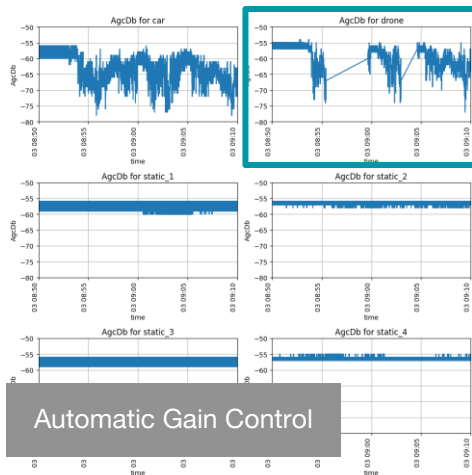
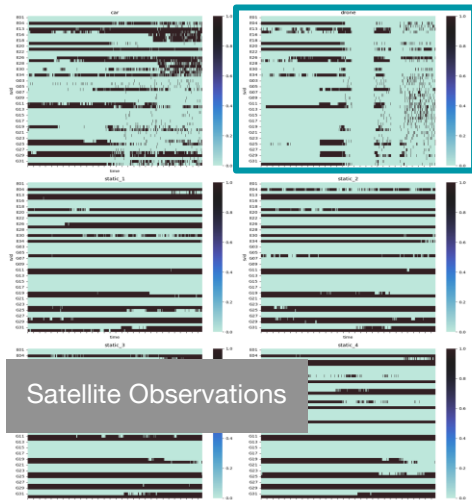
We need to be able to geolocate the source of jamming or spoofing



MITIGATION

We need to mitigate the impacts of jamming and spoofing on positioning and navigation

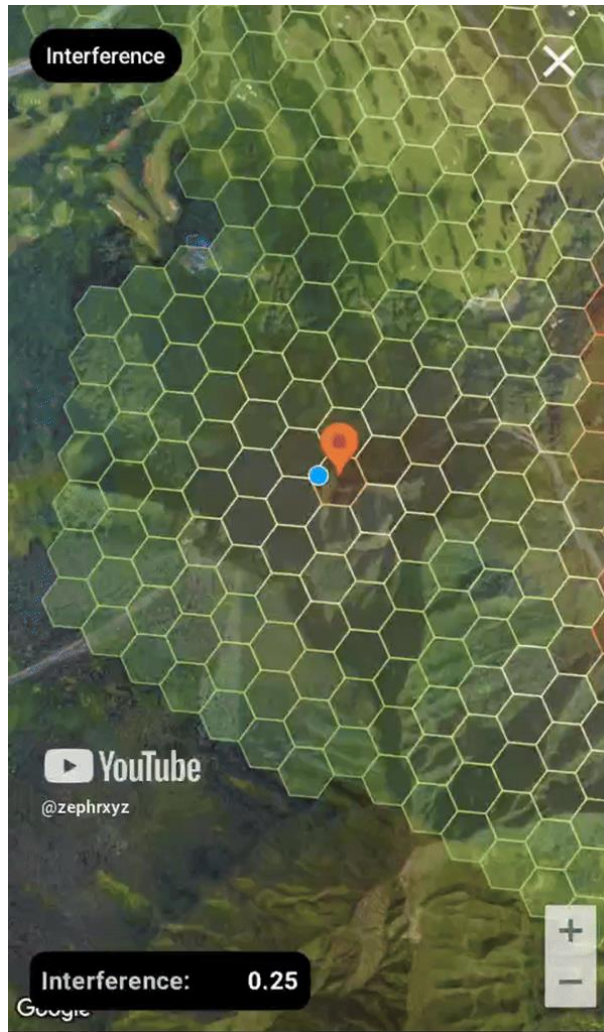




In this test there is a smartphone attached to a drone and second phone in a car along with several stationary phones out of view.

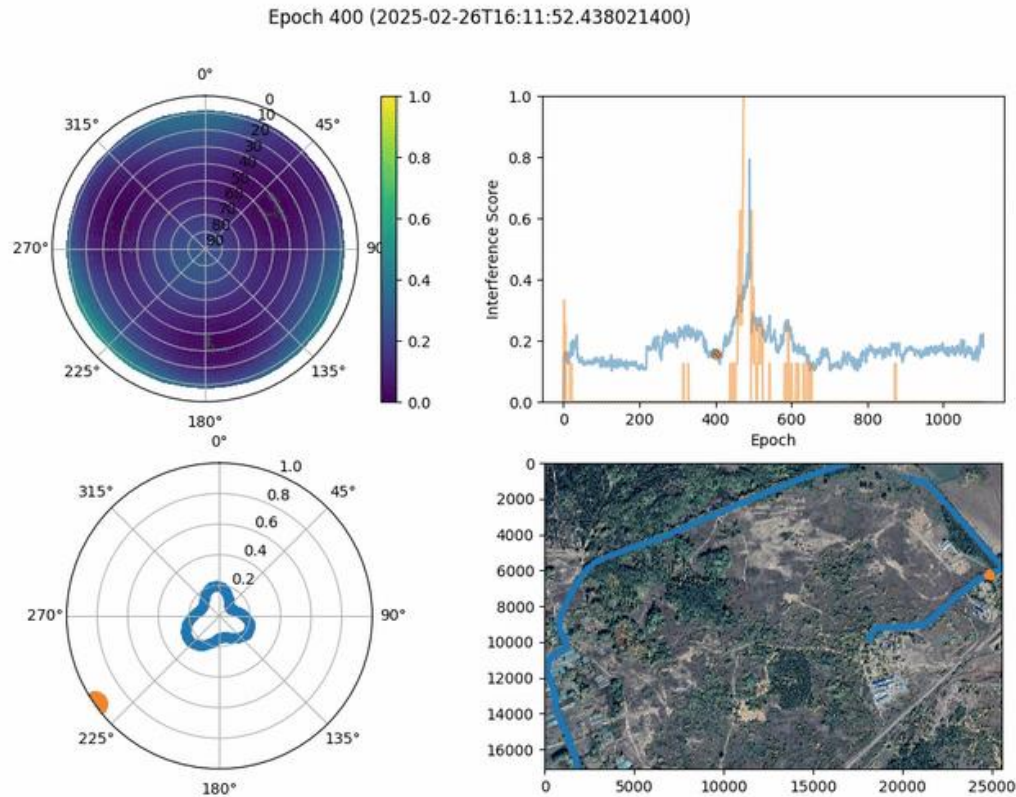
The aggregated measures from all the phones is used to interpolate an area of effect for adversarial jamming.





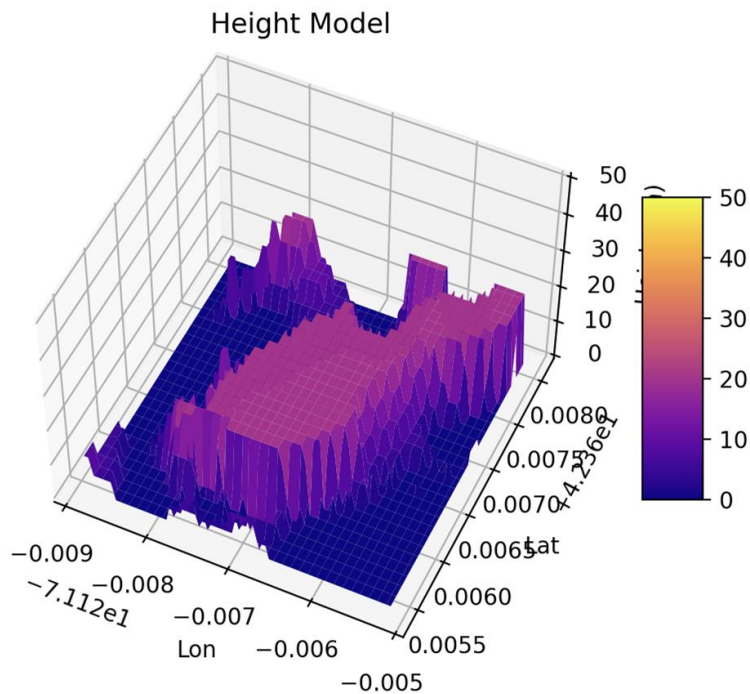
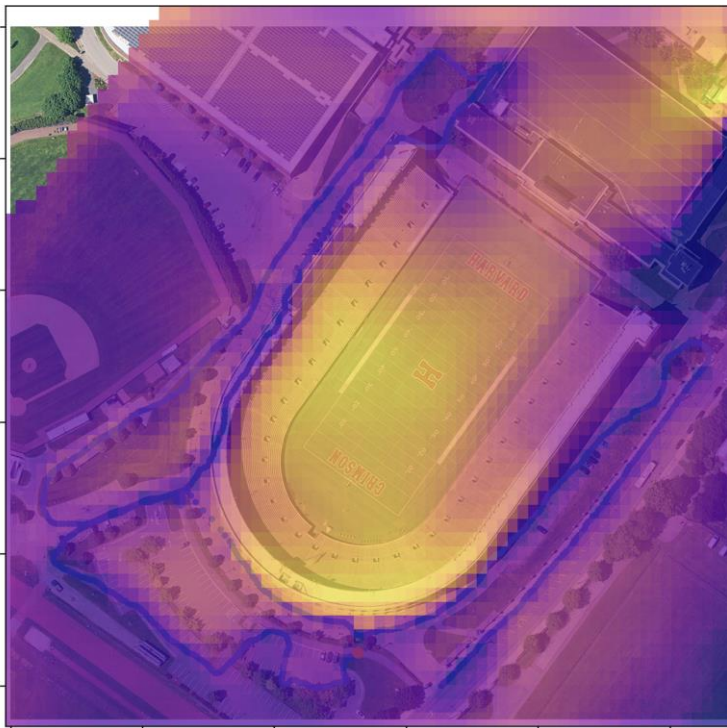
This screen capture is of Zephr's real time jamming detection and mapping app. Specifically this map is of a route through a mountain tunnel south of **Marine Corp Base Hawaii** illustrating a jammed GPS receiver.

Testing the direction of arrival of radio frequency interference using one Samsung S20 phone. The second phase will subtract natural interference to isolate the jammer



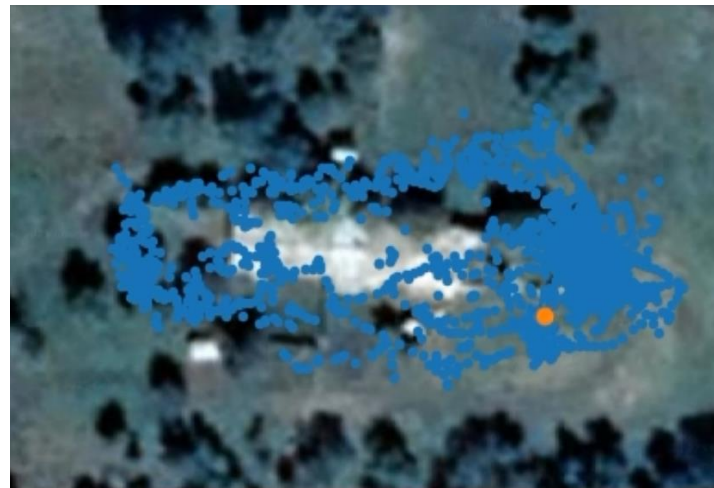
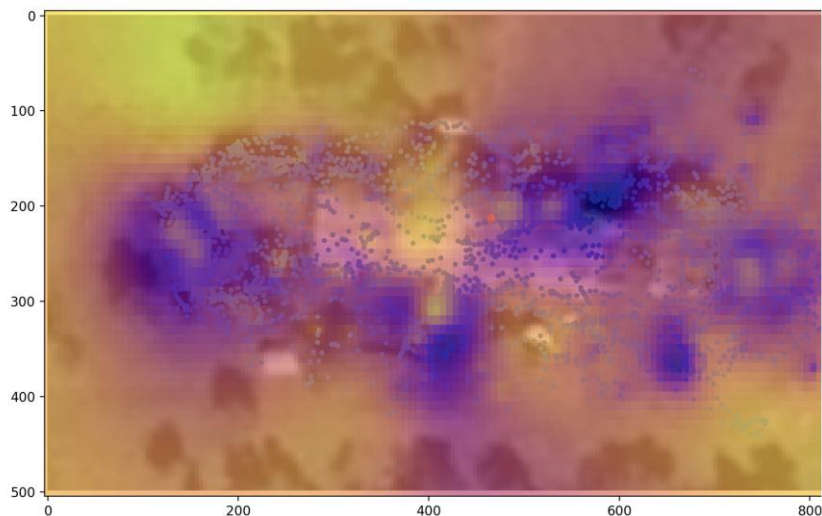
removing natural radio frequency interference

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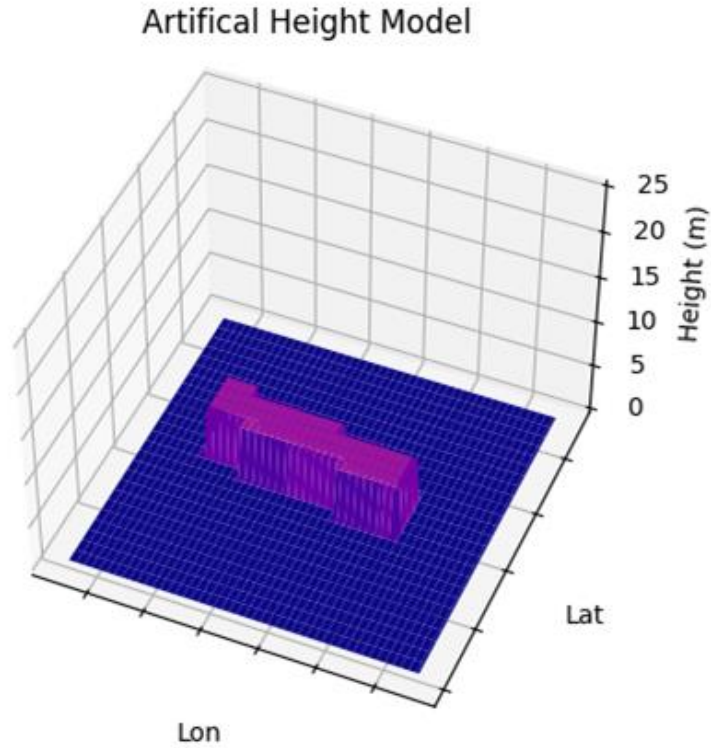
zephhr

In order to isolate adversarial jamming we need to first remove natural radio frequency interference (RFI) which also impedes GNSS signals. Here we test generating a spherical harmonic map from the residuals of the expected SNR.



When we applied the model to Ukraine we had a less clean interpolation of the spherical harmonic map that prevented us from calculating clean residual to infer the direction of the adversarial jammer.

The newly tuned model was able to clean up the spherical harmonic map and create a clean inferred height model for our test building in Ukraine. This created a situation where we could now have clean residuals to infer the heading of the adversarial jammer.

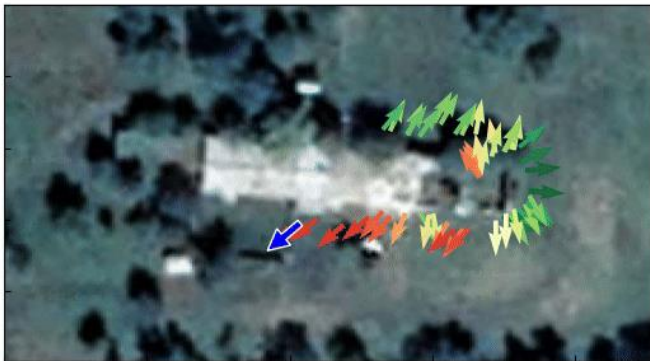
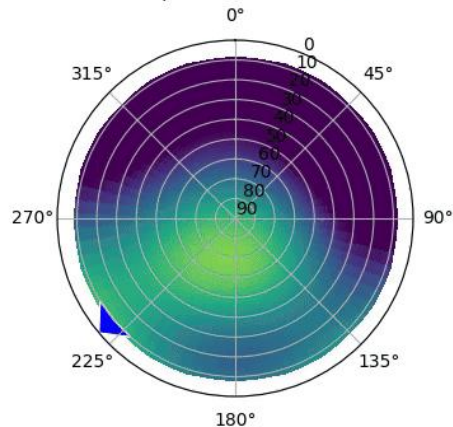


The residual map from the azimuth and elevation calculation once the the natural interference is removed leaves us with a reasonable signal from which to infer the heading of the adversarial jammer.

Once we add in headings from multiple smartphones we'll be able to make a reasonable inference of the geographic location of the jammer.

Epoch 0 (2025-02-22T15:27:02.650077600)

Residual Map (Azimuth and Elevation)



Detection and Geolocation of Signals of Interest Given Distributed End-User Devices

Agency:	Department of Defense
Branch:	Air Force
Program Phase Year:	SBIR BOTH 2024
Solicitation:	24.2
Topic Number:	AF242-D002

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The official link for this solicitation is:
<https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/>



Release Date:	Open Date:	Application Due Date:	Close Date:
April 17, 2024	May 15, 2024	June 12, 2024	June 12, 2024

field testing

Currently Zephhr is running pilots for Samsung, Hexagon, Ericsson, AWS, TGI, a Japanese automotive group*, AFRL, Ukraine MoD, Urban Traction, an AR company* and a rideshare company*.

SAMSUNG

NSIN

ERICSSON

kickstart

aws

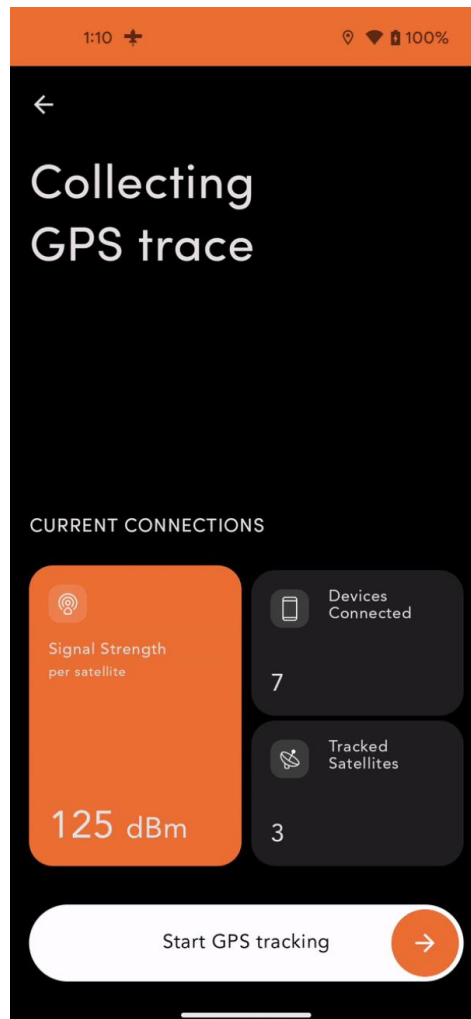
HEXAGON

AFRL
AIR FORCE RESEARCH LABORATORY



**TAYLOR
GEOSPATIAL
INSTITUTE**
LOCATION. COLLABORATION. IMPACT.

*under NDA



thank you

zephr



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