



NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

PNT research in FGI

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FGI /NLS

FGI 2022

SOLUTIONS FOR SOCIETY

SPATIAL DATA SOLUTIONS

Scientific publications
(5 years)

462

Web of Science

110

Scientific publications

Citations to our publications (5 years)

10619

Web of Science

Research man years

100

Competitive outside Financing

5,5 Me

Since 2013

6

Spin-off Companies

Scientific influence

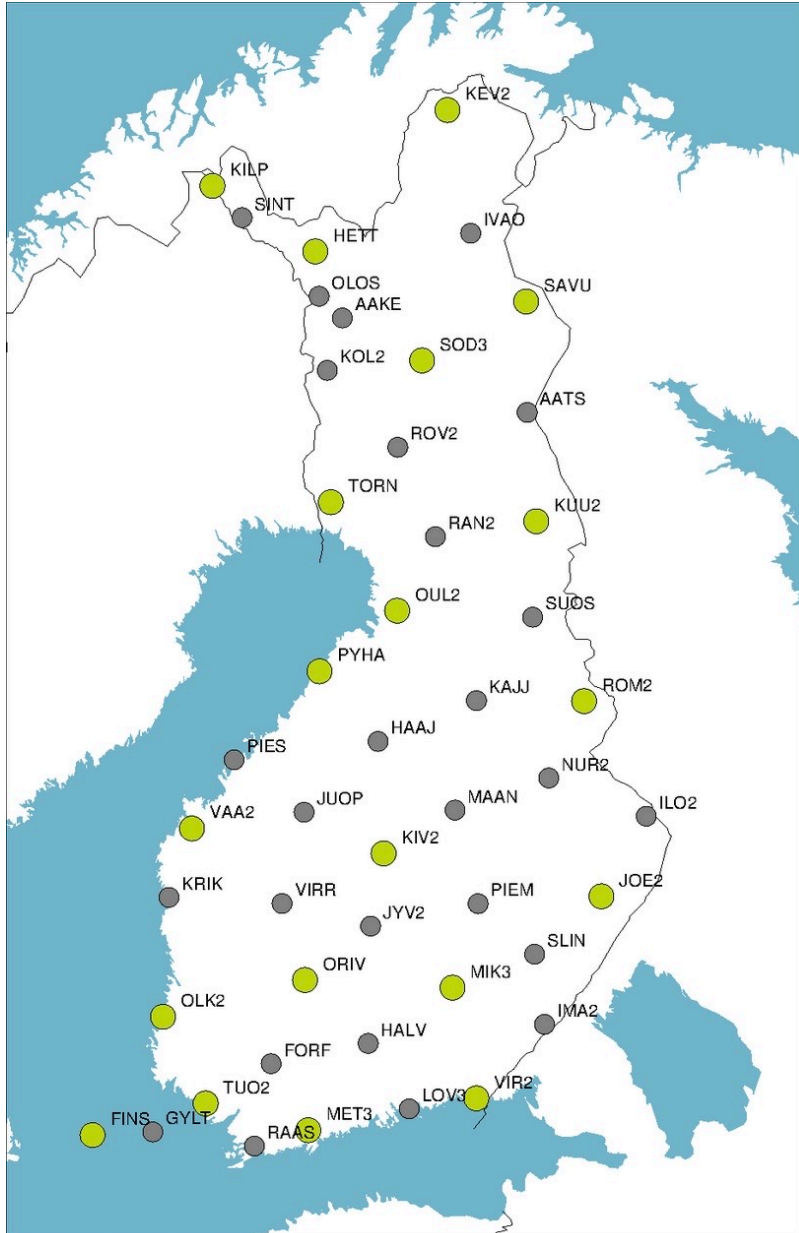
Nro 1

Finland

SPATIAL DATA IS THE FUEL OF DIGITALIZATION

FORERUNNERS OF SCIENCE AND TECHNOLOGY

FinnRef-network



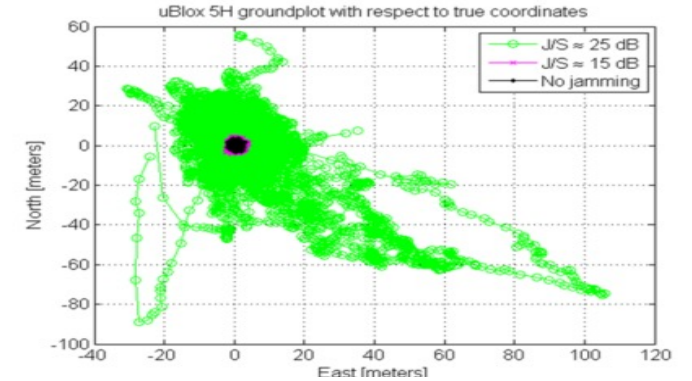
- Fundamental network of the national reference frame
- Established 1994 (13 GPS), updated 2013 and 2018 (>50 GNSS)
- Part of Nordic network, four stations in EPN and Metsähovi geodetic base station (global network)
- <https://www.maanmittauslaitos.fi/tutkimus/tutkimustoiminta/muut-tutkimus-ja-mittausasemat/finnref-gnss-asetat>



Jamming and Spoofing



Yacht hijacking shows the potential power of GPS spoofing

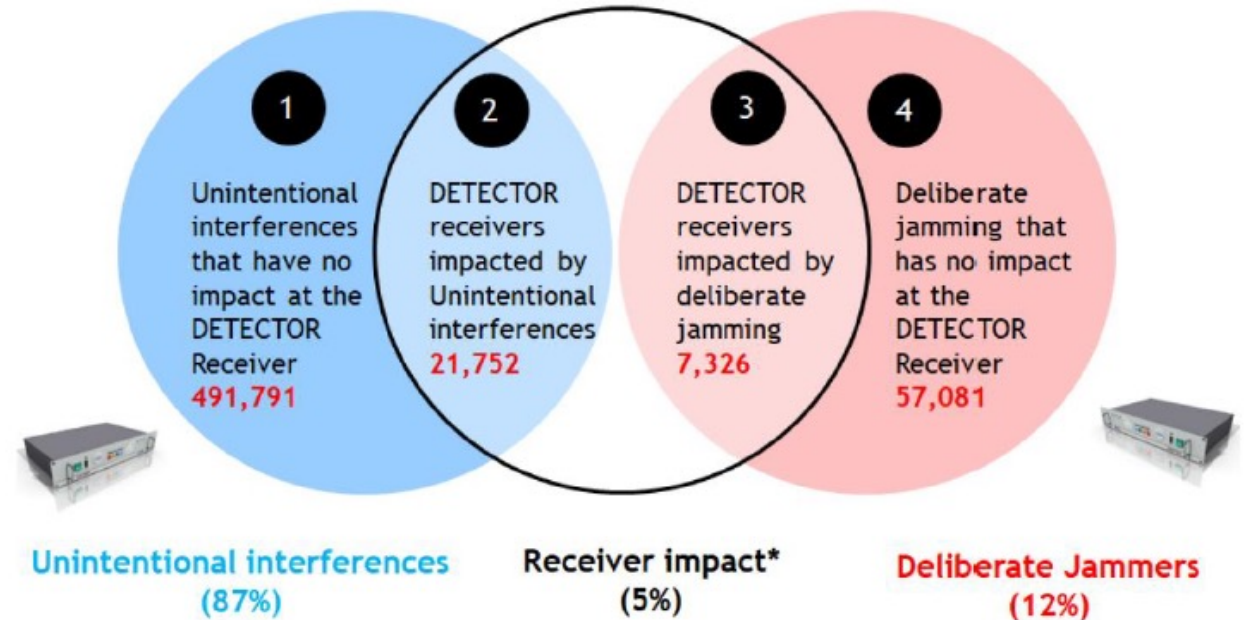


Ships fooled in GPS spoofing attack suggest Russian cyberweapon
Position shifted over 30 km

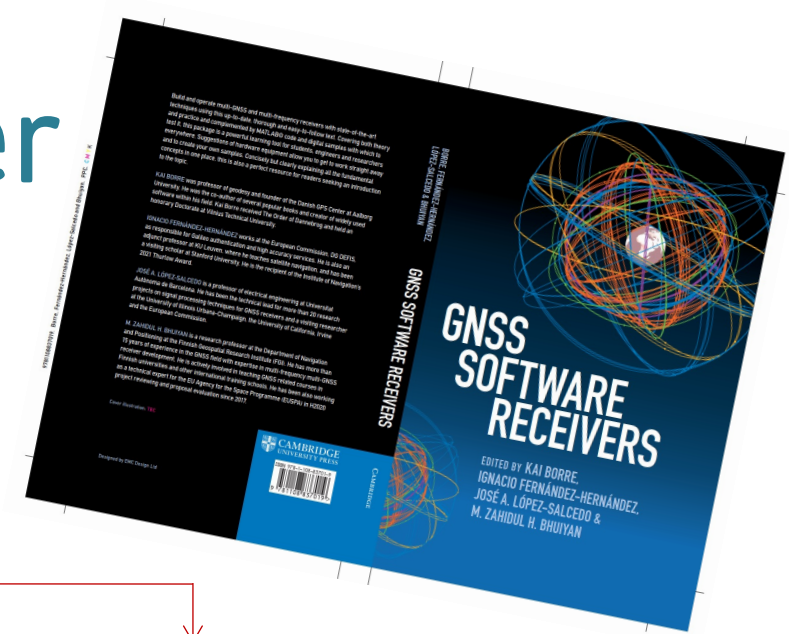


Aluksen GPS-navigaattori väitti sen olevan 32 kilometrin päässä todellisesta

STRIKE3 Breakdown of **556,198** Events



FGI-GSRx software receiver



FGI-GSRx

- **Galileo** **GPS** **BeiDou** **Glonass** **IRNSS**
- FGI-GSRx is capable of offering a navigation solution with:

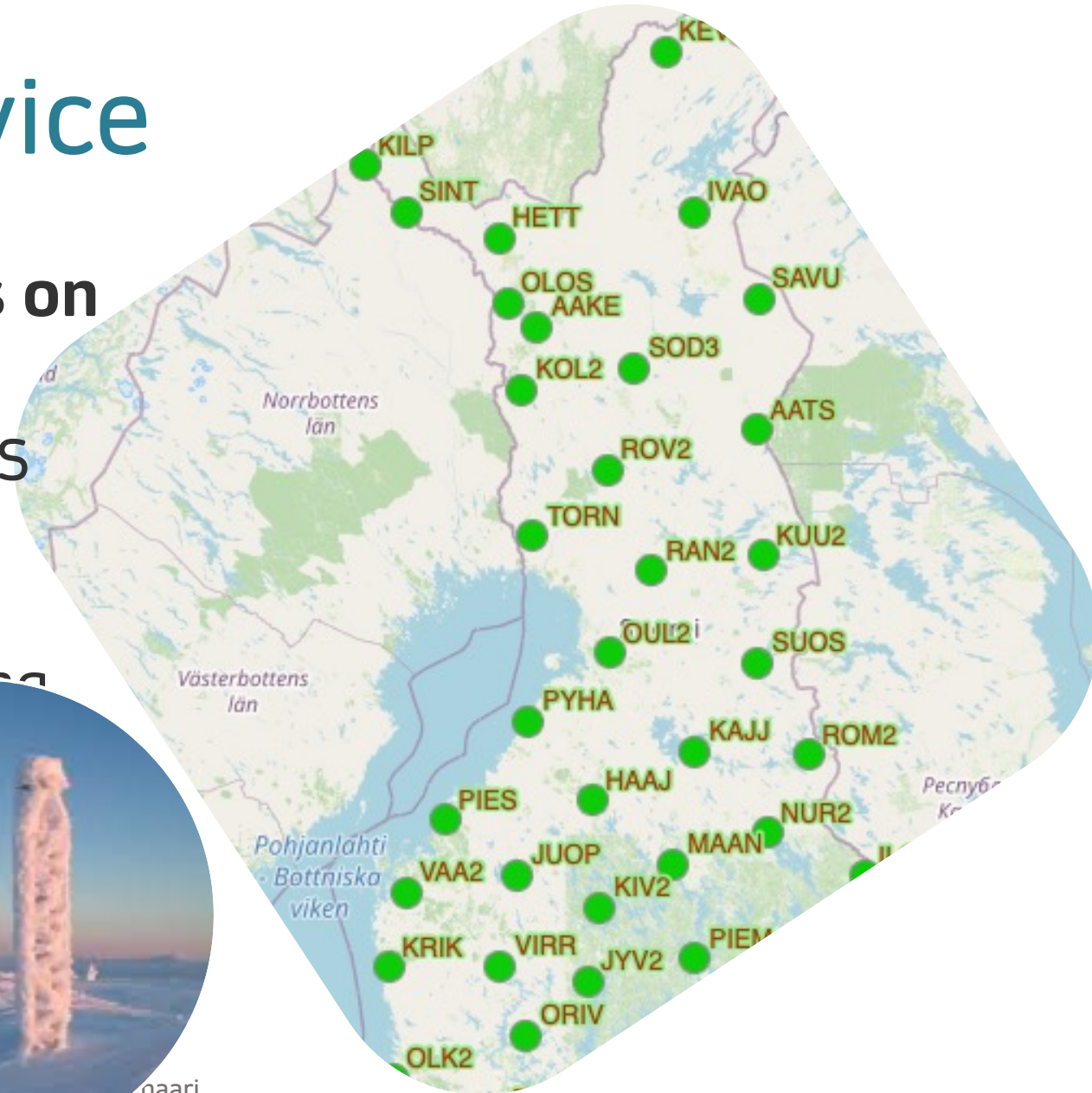
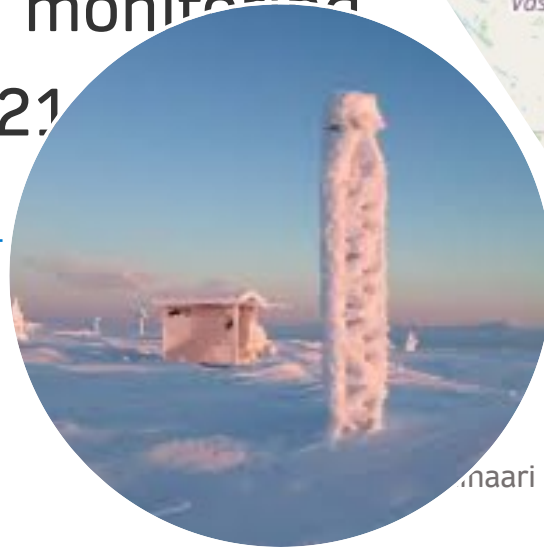
- Multi-GNSS performance evaluation in multiple frequencies
- Jamming detection and mitigation
- Data fusion with sensor positioning
- Also supports EGNOS
- Open-source version: <https://github.com/nlsfi/FGI-GSRx>

GNSS-Finland -Service

Real time situational awareness on GNSS availability

- Traffic light based map on GNSS availability:
Galileo, GPS, Glonass, BeiDou
- Based on FinnRef 24/7 monitoring
- Public service since 2021

<https://gnss-finland.nls.fi>



Forest harvesting automation



Automation in agriculture



Farmer application

- Flight planning
- Data capture flight
- Data transfer to cloud service
- Processed data transfer to farmer

Farmer controls process

- Selection of area of interest
- Scheduling tasks
- Decision making

Approximate costs

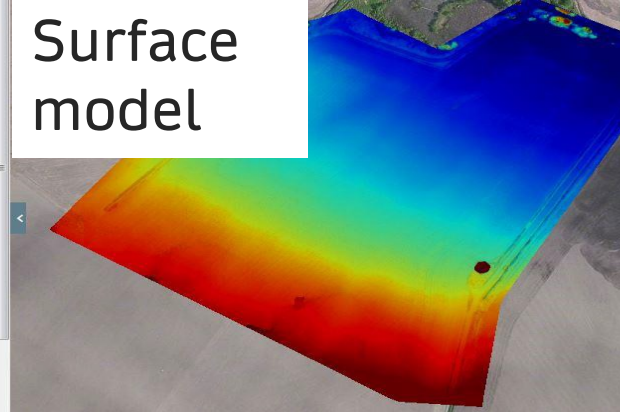
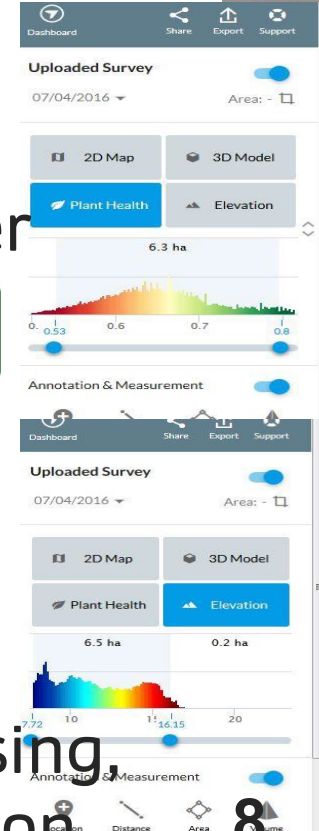
- Drone: 1000 – 2000 €
- Sensor: RGB/CIR: 500 €
- Service: 100 €/month
- Speed <1 day



Cloud service

- Image data processing, analysis, classification

<https://www.droneDeploy.com/>



Courtesy to Jere Kaivosoja, Luke

Autonomous driving Research Platform

Ford Mondeo Hybrid 2017



- Velodyne VLS-128 & 4 VLD-16 LiDAR installed on the roof of the vehicle
- One monochrome and two RGB cameras inside the vehicle viewing forward
- One radar installed in the front of the vehicle and two rear side detection radars
- GNSS-IMU Measurement unit

13
business partners

3
regions

7
reference spaces

200
spatial data services

600
data sets

5
novel sensor data sets

100
SMEs in our network

50 000
potential location data services available through European Data Portal

15
university, public sector, NGO partners

20
associated and other partners

55
countries involved



Built Environment



Bioeconomy



Health & wellbeing



Transportation

- Interoperability of location and other data**
- Precise positioning**
- Next generation navigation space**

€93.4 billion

Estimated value for the European geospatial industry market (by 2020)

59%

of the companies receive their revenue from the public sector

€13 billion

Estimated potential value of economic benefits in increasing use of location intelligence annually in Finland (Study 2019)

Conclusions

When digitalization and robotization proceeds we will be even more dependent on availability of GNSS

- We need global GNSS performance monitoring and alerting network
 - international interference monitoring HUB, Crowdsourcing, privacy issues
- We need multiple PNT sources
 - 5G, IMU, Radio, Sensor fusion, LEO PNT
- We need improved receiver and antenna technologies
 - Multi constellation, multi frequency and complex signals

Advancing together

