NEUROMATION

Where androids dream
of electric sheep

Onboard AI for Nanosat Clusters

esa

Company Overview

Tallinn
St. Petersburg
Kiev
New York City
Tel Aviv
San Francisco

Neuromation is a leading AI platform company based
in San Francisco with offices around the world

Platform-as-a-Service

Research and Development
in DL/ML

Synthetic data

Recognized by as a leading tech pioneer by **WIRED** and **TC**

Company Overview

– Neuromation's vision is to democratize AI, making it more accessible, cost-effective, and easy-to-develop and deploy.

– The company has breadth of experience in applied AI across industries and is a pioneer in the use of synthetic data and deep learning for computer vision applications.

– The Neuromation Platform provides a single point of entry for computational resources, synthetic data generation, and AI talent. It is a suite of core horizontal technologies to democratize AI, making it more accessible, cost-effective, and easy-to-use.
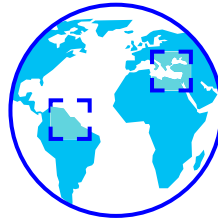
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Last Year: Our Proposal

Last year we proposed to conduct several research projects to perform scene understanding on satellite images. Many potential applications:
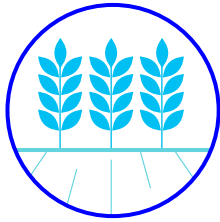
Agriculture

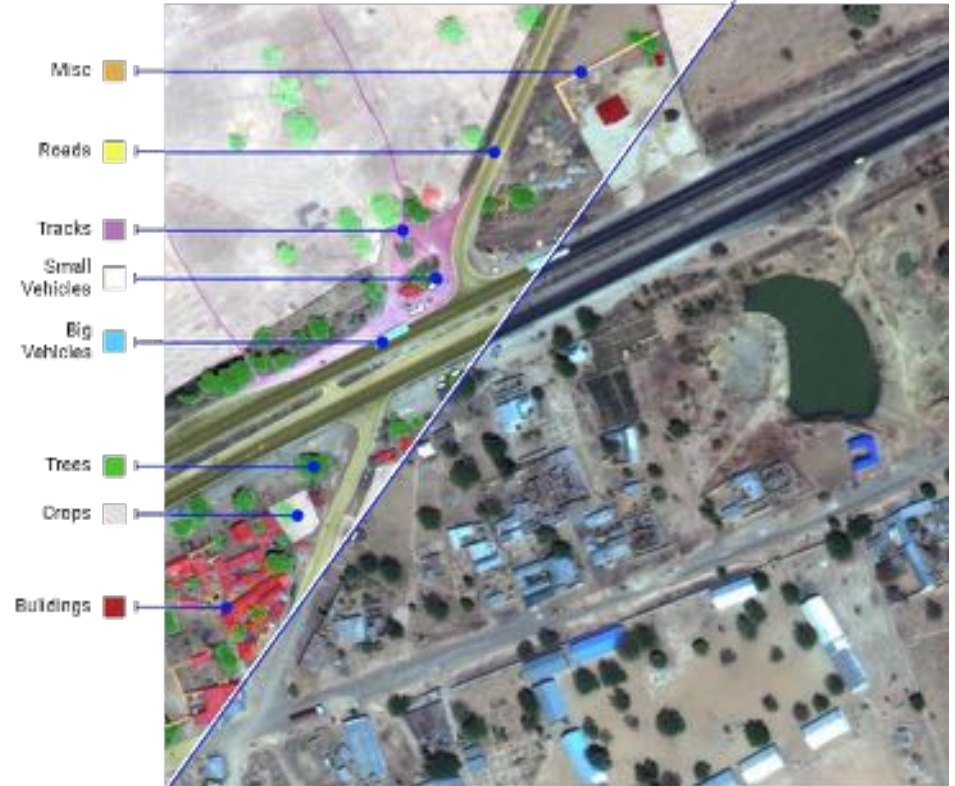Earth Studies

Ecology
and Urbanistics

Land Cover Classification

Land Cover Classification With Superpixels and Jaccard Index Post-Optimization,
A. Davydow, S.I. Nikolenko, Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, (CVPR 2018 Workshops), 2018, pp. 280–284

Read the publication

Building Detection

Building Detection from Satellite Imagery Using a Composite Loss Function, S. Golovanov, R. Kurbanov, A. Artamonov, A. Davydow, S.I. Nikolenko, Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, (CVPR 2018 Workshops), 2018, pp. 229–232

Read the publication

Predicted buildings

Satellite image

Land Cover Classification

Predicted land

Satellite image

Land Cover Classification from Satellite Imagery With U-Net and Lovász-Softmax Loss, A. Rakhlin, A. Davydow, S.I. Nikolenko, Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, (CVPR 2018 Workshops), 2018, pp. 262–266

Read the publication

Our New Proposal: Plan

Onboard AI for Nanosat Cluster to reduce power and bandwidth requirements, combined with a blockchain-enabled registry for imagery to enable distributed access and cooperative analysis by global teams

- Improved hardware efficiency makes way for extra satellite payload.

- Allows distributed teams to conduct Earth Observation more efficiently.

- Reduce latency in real-time observation applications.

- Facilitate programmatic imagery analysis for multiple variables.

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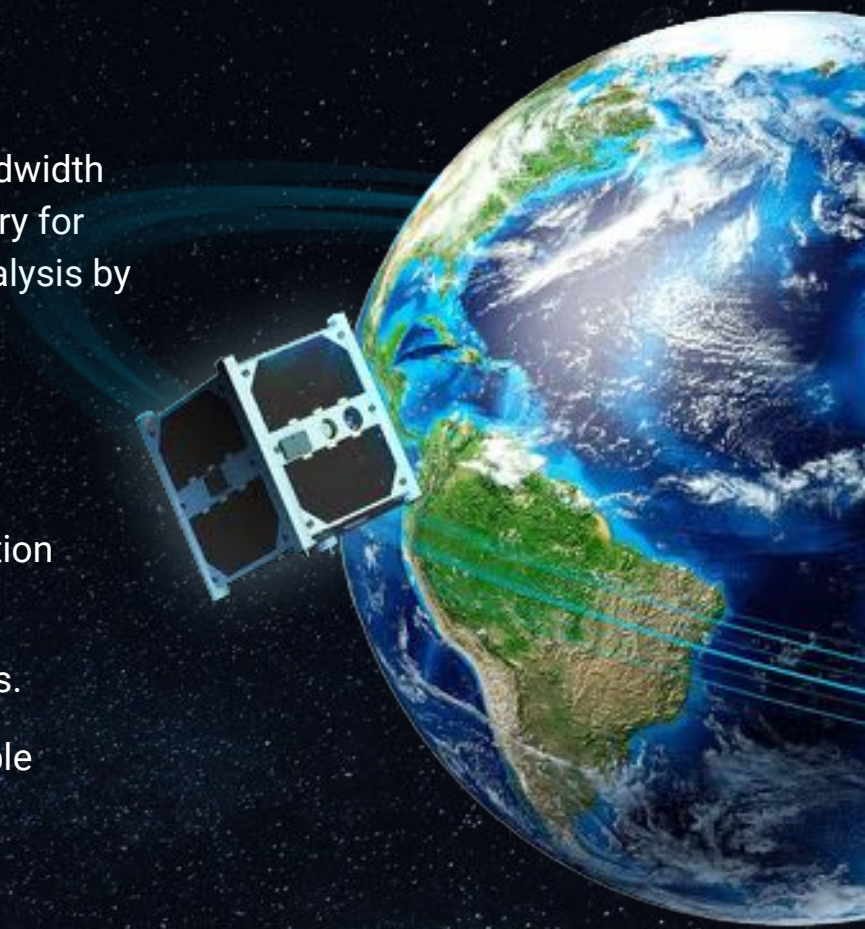
Our New Proposal: Plan

- Edge inference supporting Earth Observation

  - Dedicated AI chip/neural processing unit analyze images onboard satellite

  - Dramatically reduces data transfer and power requirements

- Hybrid blockchain to store results of all analyzed data

  - Private chain hashes for each image created by dedicated onboard hardware

  - Regular posting of associated hashes to public blockchain

-Let's dive into the details...

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Edge Inference Being Widely Adopted

- Latest generation of smartphones include dedicated AI processors:
    - Apple: A11 Bionic chip, Huawei Kirin 970, Qualcomm Snapdragon 845
    - ARM Trillium AI Project (includes dedicated object detection hardware)

- Drones

    - Skydio R1 Drone with auto-follow uses Nvidia Jetson TX2 AI computing device
    - DJI drones process images using the Myriad 2 VPU from Intel with dedicated Neural Compute Engine.

- Self-driving cars all have onboard neural networks.

    - Tesla's planned Hardware 3 chipset will analyze 2,000 frames per second with full redundancy and failover - a 10x improvement over previous Nvidia tech.

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Benefits of Edge Inference

Improved power usage

Once trained, complete tasks with greater efficiency, far less power drain

Reduced latency

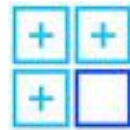Neural networks previously cloud or data center-resident leading to latency

Improved security

Alleviate data privacy concerns. data not sent to cloud

Benefits of Satellite onboard AI

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Dramatically reduce data transfer requirements: reduce size of communications hardware

Less mass and volume dedicated to power supply and communications creates other opportunities for hardware payload, such as improved optics

Faster reaction time to events

Reduced energy usage

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DLT for Decentralized Registry of Satellite Imagery

Single registry of imagery and image analysis

Faster reaction time to events, improved coordination between distributed teams

Opportunities for automation with smart contracts

SPACE AGENCIES	PRIVATE SECTOR	EDUCATIONAL INSTITUTIONS

Allow for cooperation in research and analysis by distributed global community

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DLT Technical Solution

- Onboard hardware chip for creating cryptographic hashes (fingerprint of the system state) enabling trustless data security and a shared single source of truth.

- Private Blockchain with +10000Tps such as Exonum (Bitfury Group) for storage of detailed records and analysis

- Bulk hashes posted to Public blockchain, such as Ethereum, to account for limited transaction rate and scalability issues.

PRIVATE + PUBLIC = HYBRID DLT

Benefits of DLT Technology for EO Applications

- Facilitate cooperation by distributed teams

- Create a trusted imagery registry

- Enable low cost distributed public alert systems
  and programmatic analysis of imagery

- Enable data access by educational, government
  or business users

Powerful Combination of Edge AI and DLT for EO

- This powerful combination has only recently been enabled by latest-gen commercial hardware

- Potential to dramatically improve efficiency and access

- Applications for government agencies as well as education and private sector

Market Opportunities

- **Create open marketplace for private nanosat operators**

- **Stimulate commercial nanosat manufacturing and launch systems**

- **Lower bar for entry for business users of data**

- **Allow for coordinated activity between organizations to solve global problems**
  wildlife protection, marine litter prevention and tracking, monitoring of illegal fishing activities, economic forecasting and many more.

- **Opportunities for DL/ML development teams**
  Rewards model based on algorithm competition (similar to Kaggle)

We look forward to working with interested parties.

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Data processing on-board — a new era of distributed EO

neuromation.io

Our Team

Yashar Behzadi
CEO

Andreas Wiese
Chief Marketing
Officer

Evan Katz
Chief Revenue Officer

Sergey Nikolenko
Chief Research Officer

Artyom Astafurov
CTO

Maxym Prasolov
Founder

Yuri Kundin
COO

Evgeniya Zaslavskaya
PR & Business
Development
(Russia & CIS)

Arthur McCallum
VP Digital Economy

Fedor Savchenko
VP of Research
& Development

David Orban
Adviser

Andrew Rabinovich
Adviser