

SUMMER SCHOOL OF MACHINE LEARNING 16–21 AUGUST 2020 MOSCOW

AI & Satellite Problems Laboratory of Methods for Big Data Analysis (LAMBDA)



LAMBDA • HSE



NATIONAL RESEARCH
UNIVERSITY

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Data Analysis for Satellite Tracking

Objective

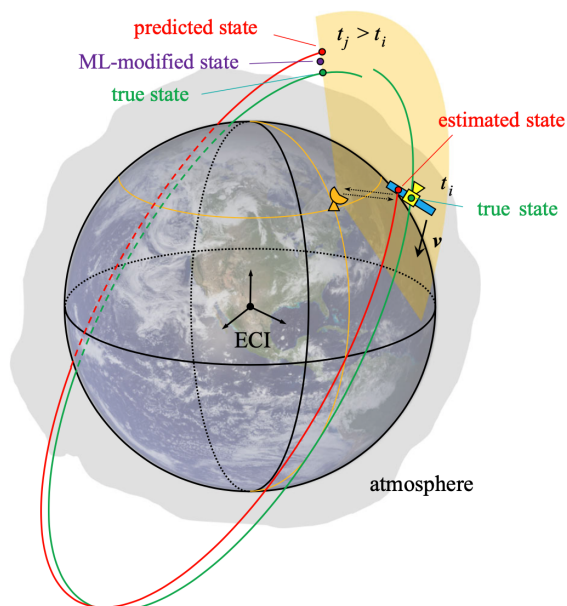
Build a model that would predict future position of space objects given previous observations.

Current Step

- experiments with simulated data
- students' experiments
- [IDAO-participants' solutions](#)
- mostly Linear Models

Partners

- [Laboratory of Methods for Big Data Analysis](#) (LAMBDA, [HSE University](#))
- [Astronomical Science Center](#) (ASC)
- [International Data Analysis Olympiad](#) (IDAO)



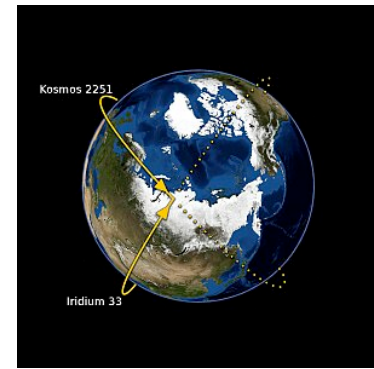
Future Plans

- determine a position of a space object comparable to the optical accuracy of the telescope
- work with real data
- ...



Space Navigator: a Tool for the Optimization of Collision Avoidance Maneuvers

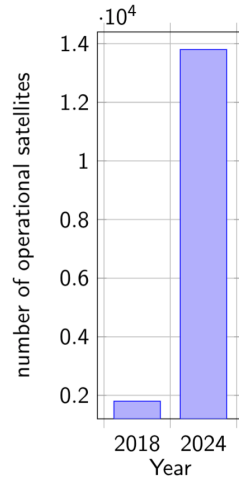
<https://arxiv.org/abs/1902.02095> (AAS Advances in the Astronautical Sciences, 2020)



wiki/2009_satellite_collision

Collision Danger in Numbers

- Debris:
 - over 22,000 pieces larger than 10 cm;
 - over 600,000 pieces larger than 1 cm;
 - a lot of collisions have already occurred;
 - collision in space -> huge number of new pieces.



- Satellites:
 - over 1,800 operational satellites in 2018;
 - over 12,000 new operational satellites are planned by 2024.
- Maneuvers:
 - collision avoidance maneuvers are necessary now (1-2 per satellite per year);
 - frequency of maneuvers will increase.

Therefore,

Tools for optimization of collision avoidance maneuvers are needed.

Space Navigator

- an autonomous collision avoidance system;
- modular - replaceable simulators;
- arbitrarily objective function -> copes with different cases;
- user-friendly – user can adjust parameters;
- multi-Debris (up to 10 objects in experiments);
- based on Reinforcement Learning;
- includes a Virtual Reality system.

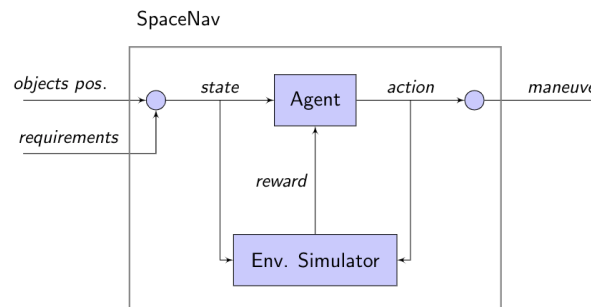
Current Step

- MVP
- Paper

Future Plans

- develop GUI for SpaceNav;
- add optimization of sequence of maneuvers;
- integration with maneuver data sources;
- elaboration of integration into systems of the ground control complex of space objects.

Architecture (simplified)



Partners

- Phygitalism;
- Roscosmos Corporate Academy.

