Toward autonomous satellite operations and monitoring using machine learning

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Born at OSCW ‘18

pic by @ddialar

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What is Polaris?

“Python tool for exploring and analyzing telemetry data obtained from the SatNOGS network”
Outline

- What is Polaris?
- The project’s architecture
- Live demo
- Next steps
- Conclusions
Some figures

- 68 members in Riot
- 352 commits by 7 different contributors
- 48 Merge Requests
- 47 Issues
- 2 summer of code students
The architecture

Polaris pipeline
polaris fetch
polaris learn

```bash
$ polaris learn
```

Diagram:
- Feature engineering
- Hyperparameter
- Feature dependency and relationship
polaris viz

$ polaris viz

Dependency graphs -> web server -> User
Demo: LightSail-2 telemetry analysis

https://deepchaos.space/
Next steps

$\textit{polaris fetch}$

- SpaceTrack (or Satellite)
- GetNOSS Network
- Other sources of information

$\textit{polaris learn}$

- TLE propagation
- Decode telemetry
- Normalize telemetry
- Orbit propagation
- Telemetry
- Context and ancillary data info

$\textit{polaris viz}$

- Hyperparameters
- Users feedback
- Prediction
- Behavioral classification
- Feature dependency and relationship
- Dependency graphs
- (On-demand) predictions
- Outliers and warnings

web server

User
Conclusions

- We have already found interesting things with fairly simple analysis
- We will need to collaborate with satellite operators to validate the results
- Bigger constellations will yield even better results

“Polaris can be used not only for automating operations, but it can also find deeper relationships and run more complex analysis than what a human would do”
Tips for summer of code projects

- Build a team of mentors
- Be aware of the amount of time required (mentors and students)
- Give students a clear roadmap
- Pick students who had previously collaborated with the project
- Have a good onboarding process
Special thanks

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- Redouane Boumghar, Hugh Brown and Patrick Dohmen

The project contributors:

- Aditya Malshikhare, Jan-Peter Ceglarek and Julien Flawinne

The supporting organizations:

- Libre Space Foundation, European Space Agency and Google
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