

## Student Thesis (BA/MA)

# Verification of the numerical propagator Neptune

The backbone of any SST (Space, Surveillance and Tracking) system is a suitable propagator. This is a software that provides a mathematical model to predict future positions of objects in orbit. Okapi uses the NEPTUNE propagator developed at the Institute of Space Systems. This propagator considers all relevant perturbations in earth orbit (geopotential, atmospheric resistance, third body interference, etc.) and uses a Störmer-Cowell integrator to integrate the equations of motion. In addition to pure position extrapolation, propagators are used in statistical orbit determination. Here they serve as a mathematical model to adapt the state description of the object to actual observations. For the adaptation there are different methods available, examples are Least-Square methods or different Kalman filters.

Neptune has been used very successfully in many simulation campaigns. However, so far a comprehensive verification of the software is missing. Verification means that simulated results are compared with those of actual objects in Earth orbit and the resulting deviation is described. This shall be done for the orbit prediction as well as for a part of existing orbit determination methods. In detail the following points are to be worked on:

- Familiarize with the topics of orbit propagation and statistical orbit determination.
- Research of available reference data, both for orbit determination and propagation (e.g. ESA Satellite, Laser-Ranging data, etc.).
- Perform simulations based on the researched data.
- Comparison of results and documentation.
- Depending on the type of work: planning and execution of own measurement campaigns with the help of sensors available from partners (telescopes, laser ranging systems).

OKAPI:Orbits is a spin-off start-up at the Institute of Space Systems of the TU Braunschweig, Germany. Our focus is to provide the NewSpace market with software for the safe operation of satellites in Earth orbits in a simple way. More information about us can be found at [www.okapiorbits.space](http://www.okapiorbits.space).

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