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An Open-Source Wrapper for Basilisk Simulations

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Simulating the trajectory at low altitudes is challenging. The complex dynamics include Earth atmospheric drag, Solar Radiation Pressure, and gravitational perturbations from the Sun, the Moon or other planets. Implementing these effects can be tedious for actors designing complex trajectories, reentry strategies, or autonomous decision-making solutions. This highlights the need for a comprehensive and easy-to-use framework.

Many existing software packages and libraries can model satellite motion and provide common perturbation models. Among these, the open-source Basilisk framework stands out for its modular architecture, ability to represent multiple interacting systems, and suitability for hardware-in-the-loop testing.

However, Basilisk's steep learning curve and developer-oriented design can be a barrier to newcomers and to rapid prototyping of mission-specific tools. To bridge this gap, we are developing GECKO, a lightweight wrapper that streamlines Basilisk usage and simplifies the integration of external modules. It eases the use of Basilisk for applications such as testing autonomous decision-making algorithms, simulating deorbiting strategies, or experimenting with reinforcement learning (RL) for trajectory optimization. Our current focus, which led to the development of Basilisk, is on building a Conjunction Data Message (CDM) generator to emulate realistic collision-warning scenarios in Low Earth Orbit, enabling the testing and validation of autonomous decision-making algorithms.

By lowering the entry barrier to Basilisk, GECKO aims to foster collaboration and accelerate open-source innovation, with scalable simulations for RL training and hardware-in-the-loop capabilities for onboard validation.

Auteur: Dr BOURIAT, Simon (AIKO - ISAE-SUPAERO)

Co-auteurs: BAKER, Aurélie (AIKO); Dr RIMANI, Jasmine (AIKO); PINTEAU, Paul (ISAE-SUPAERO); Dr LIZY-DESTREZ, Stéphanie (ISAE-SUPAERO); GATEAU, Thibault (ISAE-SUPAERO)

Orateur: Dr BOURIAT, Simon (AIKO - ISAE-SUPAERO)

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