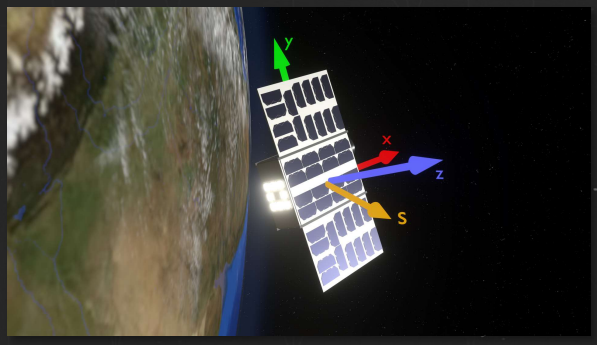
360 by IENAI

360™ by IENAI SPACE is a cutting-edge mission analysis tool conceived for high-fidelity simulations, propulsion system design and optimization, concurrent engineering of subsystems and definition of propulsive maneuvers. The tool considers spacecraft subsystems and operations in the design and optimization processes, providing sets of realistic solutions from feasibility studies, up to detailed design phases.



360™ uses include:

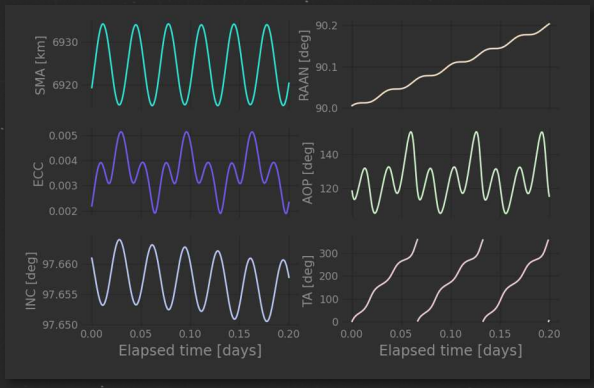
- Optimal propulsion system selection.
- Concurrent engineering for propulsion system and codependent subsystems (EPS, ADCS, etc.).
- Monte-Carlo simulations for robust analysis.
- Detailed design of propulsive maneuvers for spacecraft operations.

REALISM & HIGH FIDELITY

360™ is built upon a high-fidelity propagator. Orbital and attitude dynamics can be propagated either simultaneously or individually, depending on the study to be carried out. State-of-the-art environmental perturbations models are included. The models and their parameters can be selected depending on the level of fidelity needed for the analysis.

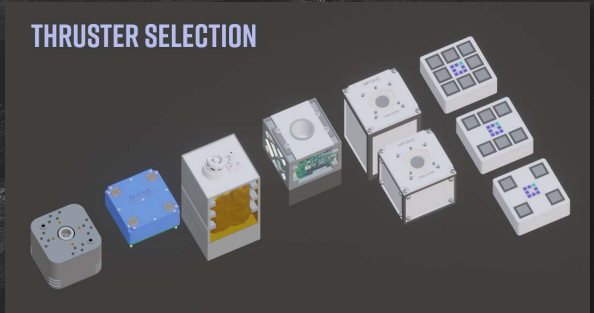
Computed perturbations include:

- Gravity and gravity gradient.
- Atmospheric drag and torque, varying fidelity density models and space weather indexes, updated daily from NOAA.
- Magnetic field torques.
- Solar radiation pressure force and torque.
- 3rd body perturbations for satellites at high altitudes.



360™ includes spacecraft subsystem models, with varying levels of detail and the possibility of adding custom and COTS models for increased realism and fidelity:

- High fidelity propulsion system models for IENAI's ATHENA™ and existing COTS systems.
- Power generation and storage subsystems, from simplified energy balance models to individual solar cell performance.
- ADCS & RCS.
- Other subsystems available as simplified models: payloads, communications, data handling, etc.



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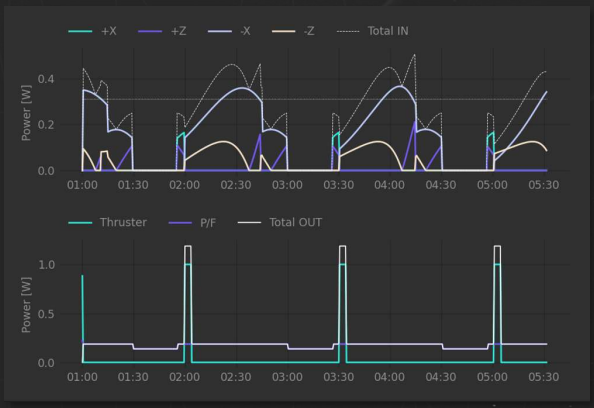
IENAI SPACE

360™ uses an event-based framework for orbital events (eclipses, visibility) and operational behaviors (on/off switches, attitude and spacecraft modes), allowing for complex operational constraints.



OPTIMALITY & VERSATILITY

360™ includes advanced control law algorithms directly in the high-fidelity propagator, allowing to generate near-optimal guidance laws for low-thrust maneuvers such as:

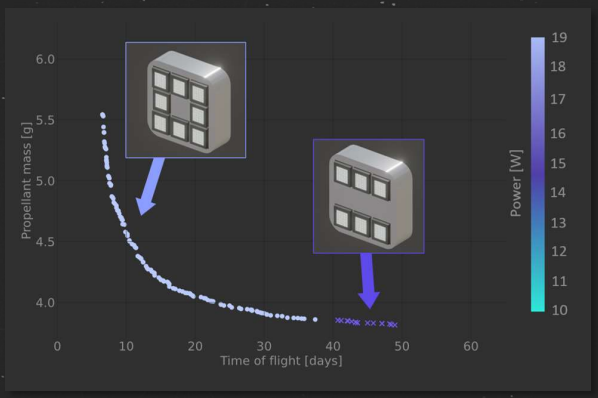
- De-orbiting.
- Early collision avoidance.
- Station-keeping.
- In-plane phasing and constellation deployment.
- Orbit maintenance and reconfiguration.

360™'s high-fidelity core is coupled to a state-of-the-art Genetic Algorithm, deployed on a cloud computing platform, ***allowing the mission analysis software to solve multi-objective optimization problems*** for continuous and discrete design variables, providing unbounded versatility without requiring initial guesses and guaranteeing global optimality.

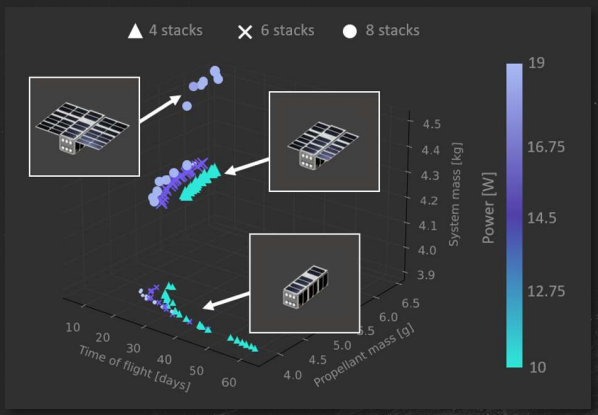
EXAMPLE CASES

360™ can perform a variety of default studies and analyses at different project phases and lifecycle:

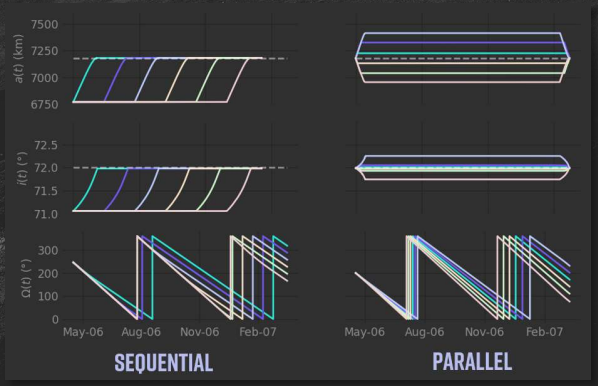
- Propulsive requirements definition: ΔV, total impulse, etc.
- Concept feasibility and down-selection of propulsion options.
- Optimized thruster and propulsive maneuver design for IENAI's ATHENA™ (or configurable COTS thrusters).



- Concurrent design of IENAI's ATHENA™ (or configurable COTS thrusters) and spacecraft subsystems: ADCS, EPS.



- Propulsive phase definition and optimization including constellation deployment strategies and *full space mobility problem:* launchers, OTVs & on-board propulsion.



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