Republic of Poland

NCBR National Centre for Research and Development

Attachment no 1

for the inquiry no 27/PIAST/2022

Technical parameters

Order subject: Software delivery: STK Premium or equivalent with perpetual desktop license

Brief description of the device: Software: STK Premium or equivalent with perpetual desktop license

CPV code and name: 48460000 - Analytical, scientific, mathematical, or predictive software packages

I. Minimal technical requirements of the software:

1. Core software capabilities
    a. Modelling complex systems and entire system-of-systems
    b. Provide physics-based, time-dynamic, three-dimensional environment simulation
    c. Visualisation of analyses results via 3D animations, graphs, and reports.
    d. Analysis and Output Functionality:
        i. Determine the times at which an object can access (see or communicate with) another object within the simulation.
        ii. Enhance computational capability with customized functions and calculations.
        iii. Compute the quality of a coverage access over an area of interest (i.e., revisit time, coverage time, accesses per day).
    e. RF modelling and Analysis
        i. Build high fidelity models of communication systems for analysis.
        ii. Capability to import detailed transmitter, receiver, antenna, and radar models.
        iii. Conduct link budget analyses to evaluate the communications system performance on the mission.
        iv. Simulate and model radar systems, including synthetic-aperture radar (SAR), to evaluate their performance.
        v. Terrain Integrated Rough Earth Model capability to consider propagation loss due to terrain.
    f. Capability to compute in parallel for faster results.
    g. Integration interfaces and integration compatibility with MATLAB and Python.

2. Software for modelling high-fidelity space systems:
    a. Space Mission Systems design through space-based system modelling, including the following capabilities
        i. Mission planning capabilities to develop, optimize and validate spacecraft trajectory solutions.

1. Segmented trajectory design to generate final ephemeris including all flight mission phases.
2. Maneuver simulation, including maneuver pointing and thrusting strategies, as well as mechanisms for their optimization. i.e., rendezvous and proximity operations.
3. High-fidelity customizable force models.
4. Advanced search and optimization, to accurately achieve optimal trajectories to satisfy the mission objectives.
5. Highly customizable variables and conditions for flexible analysis.

ii. High-fidelity satellite systems modeling and analysis.
1. High-fidelity Orbit Propagation.
2. Satellite covariance computation.
3. Power generation modelling through solar panels.
4. Satellite lifetime analysis.
5. Attitude states simulation and attitude behavior over time.
6. Generation of object constellations and Walker constellation models.

iii. High-fidelity modelling of the near-Earth space environment, including spacecraft exposure to ionizing particles, thermal radiation, and space debris.

iv. Conjunction analysis capability to assess potential collisions in space.
1. Feature to analyze conjunction events between a primary satellite, or a set of primary objects, and a set of secondary objects, considering threat volumes.
2. Feature to determine blackout times in a launch time window to avoid a potential conjunction with a secondary object.

b. Advanced Analytical capabilities, including

i. Parametric trade study designs including Design of experiment, Monte Carlo-based probabilistic analyses, and optimization algorithms.

ii. High resolution global terrain, imagery, and data mapping.

iii. Real-Time tracking Technology and distributed simulations capabilities for real time data feeds and interoperability with integrated 3rd party applications.

iv. Electro-optical infrared sensors modeling for detection, tracking and imaging performance, including
1. Target modeling through specifying shapes, dimensions, surface materials and temperatures.
2. Multisensor analysis with multiple independent steered sensors.
3. EOIR (Electro-Optical Infrared) multiband sensors modeling.
4. High-fidelity atmospheric models to calculate transmission and scatter radiance, including clouds effects.
5. Earth surface model for interference, including reflectance, emissivity, and temperature texture.

6. Celestial bodies models, including star catalogs for precise position modeling.

c. Space Operations, and multidomain Concept of Operations