1.) Configuration Instructions

The updated *montecarlo_wrapper.cpp* file is located in the same folder as this document (IEEE-Aerospace-26/Angel-M-Draft-Contributions). The *.cpp* file should be placed in a new directory inside the *gmat-git/application/bin/* path. In my example, I made a directory called "MonteCarlo" and placed the *.cpp* file inside.

```
amartinez@ubuntu:~/gmat-git/application/bin$ ls
GMAT          GmatConsole-R2025a  gmat_startup_file.public.txt            gmatpy                libGmatUtil.so.R2025a
GMAT-R2025a   MacConfigure.txt    gmat_startup_file.txt                   libGmatBase.so        load_gmat.m
GMAT.ini      MonteCarlo          gmat_startup_file_mac_linux.public.txt  libGmatBase.so.R2025a montecarlo_driver
GmatConsole   __pycache__         gmat_startup_file_mac_linux.txt         libGmatUtil.so
amartinez@ubuntu:~/gmat-git/application/bin$ cd MonteCarlo/
amartinez@ubuntu:~/gmat-git/application/bin/MonteCarlo$ ls
montecarlo_wrapper  montecarlo_wrapper.cpp
```

Since I am running Ubuntu 22.04 on WSL, I installed the packages for MPI using the command: *"sudo apt install openmpi-bin libopenmpi-dev"*. Then to compile and run:

> **Compile:** *mpic++ montecarlo_wrapper.cpp -o montecarlo_wrapper*

> **Run:** *mpirun -np <number of threads> ./montecarlo_wrapper*

When running, the script will generate a *.scripts*, *.log*, and *.csv* file for each MonteCarlo trajectory simulation

2.) How To Use Script

A1ModJulian → (Jan 1 2025 12:00)

MonteCarlo Variables:
- *h0_km* →initial altitude
- *Cd* →drag coefficient
- *A2M* →area-to-mass

Input defined Variables:
- *--n* →total number of Monte Carlo simulations (default: 50)
- *--mass* →satellite mass in kg (default: 200.0)

- *--capDays* →Max days to propagate if no decay (default: 30.0)

Why is <122km considered decayed?

NASA defines 122 kilometers for re-entry altitude:

https://www.planetary.org/articles/3192#:~:text=NASA%20defines%20122%20kilometers%20for,exceed%20the%20spacecraft's%20structural%20strength.

LEO Range:

180km to 2000km

https://spire.com/spirepedia/low-earth-orbit/#:~:text=Low%20Earth%20Orbit%20(LEO)%2C,LEO%20interact%20with%20the%20atmosphere.

Drag coefficient:

Visual Example of Simulation: