Design Decisions - Reaction Wheel Module

This reaction wheel system was designed to be compact, 3D-printable, and modular, suitable for integration into a CubeSat-class spacecraft. The following key design decisions were made:

- **Volume Optimization:**
  The entire assembly was constrained to fit within a 60 mm x 60 mm x 69 mm housing, keeping the total volume under the specified 250 cm^3 limit. This ensured compatibility with satellite form factor requirements.
- **Flywheel Geometry:**
  A 50 mm diameter flywheel with 8 mm thickness was selected to maximize moment of inertia while ensuring adequate clearance within the enclosure. The flywheel was designed for uniform mass distribution and rotational balance.
- **Gear-Based Torque Transmission:**
  A gear system was used between the DC motor and the flywheel shaft. A 10-tooth external gear drives a 24-tooth internal gear, resulting in torque amplification, ideal for generating controlled angular momentum.
- **Motor Mounting and Axis Offset:**
  The DC motor is mounted 3.5 mm off-center to accommodate the gear mesh with the internal gear. The motor mount was custom-modeled to ensure tight fitment and structural rigidity, while allowing for proper shaft alignment.
- **Material Selection:**
  All components were modeled using ABS plastic (as defined in SolidWorks), representing realistic 3D-printing material properties. This allowed accurate mass and inertia calculations throughout the design process.
- **Printability Focus:**
  Every part was intentionally designed with **zero overhangs**, eliminating the need for support structures during 3D printing. All geometries are clean and self-supporting, ensuring straightforward and efficient fabrication.

This design prioritizes balance, printability, and functional performance, laying the groundwork for reliable attitude control when paired with embedded control logic and sensing systems.

STL Orientation Note

The exported STL files are oriented in the Z-up direction, as defined during design in SolidWorks. While this orientation is consistent in both the CAD environment and GitHub STL previews, it is not necessarily optimized for 3D printing. Prior to printing, each part should be reoriented appropriately within slicing software such as Ultimaker Cura to ensure flat base surfaces and support-free printing. This adjustment is standard practice and ensures better printability without altering the model geometry.