

FLYWHEEL ENERGY STORAGE SYSTEM

Personal Project | Feb 2022 - Apr 2022

CONTEXT

Inspired by **clean and sustainable energy**, I decided to take up this project - **Flywheel Energy Storage Systems (FESS)** as **mechanical batteries**. The system mimics **regenerative braking in electric vehicles**, storing rotational energy and converting it back to electrical power. This hands on project helped connect theoretical physics (kinetic energy, moment of inertia) with practical design, energy storage and **efficiency maximization**.

GOALS

- Design and build a working flywheel energy storage system which can spin at high rotational speed and recover energy
- Use the system to demonstrate how kinetic energy can be captured during deceleration (similar to regenerative braking)
- Explore gear based power transmission under high torque loads
- Quantify energy recovery using motor / generator and LED array
- Calculate system efficiency and maximize it

TECHNICALITIES

Mechanical Design:

- Designed the flywheel system in **SolidWorks** using a motorcycle brake disc for high inertia.
- Calculated the moment of inertia and supported the system using radial ball bearings.

Power Transmission:

- Iterated through 3 drive systems - **timing belts**, **spur gears** and finally **double helical gears (herringbone gears)** which offered quiet and high torque transmission.

Motor Control & Recovery:

- Used a 555 timer based PWM controller to spin the flywheel to ~2300 RPM.
- Switched to generator mode with a DPDT switch, powering an LED array and recovering energy visibly.

Testing & Analysis:

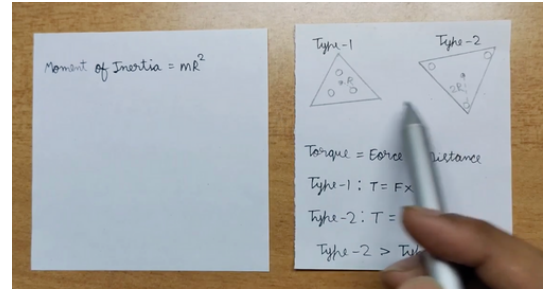
- Manually tracked RPM, measured energy transfer and identified loss contributors like friction and generator inefficiencies. Some future improvements include using **magnetic bearings**, BLDC motor and a better DC-DC converter for stable output voltage.

RESULT

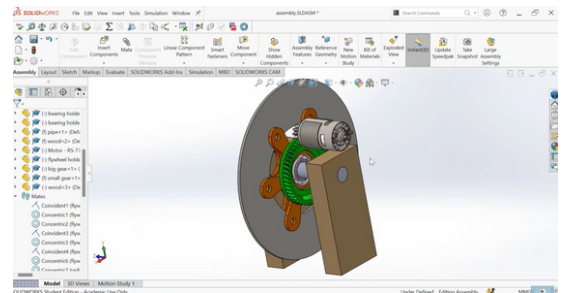
- Built a fully functional FESS prototype that visibly recovered stored energy
- Demonstrated **bidirectional motor & generator** operation
- Measured performance metrics like RPM, input and output power and system behavior during energy conversion.



[Link to the Youtube video!](#)



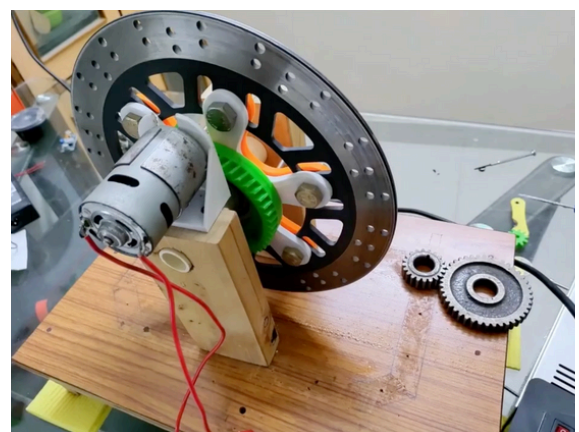
Performed basic physics calculations and understood theory behind flywheel batteries



CAD model in SolidWorks



Flywheel (motorcycle brake disk) with herringbone gears



Final setup of the FESS