

FLYWHEEL ENERGY STORAGE SYSTEM

Personal Project | Feb 2022 - Apr 2022



[Link to the Youtube video!](#)

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:

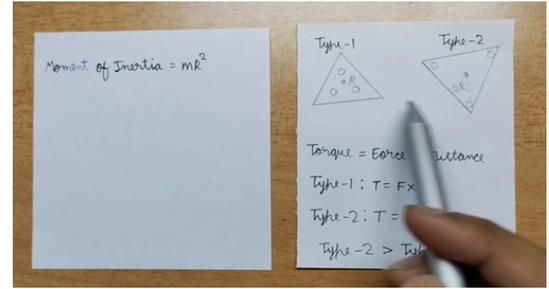
- Used a 555 timer based PWM controller to spin the flywheel to ~2300 RPM.
- Switched to generator mode with a DPDT switch, powering an LED array and recovering energy visibly.

Testing & Analysis:

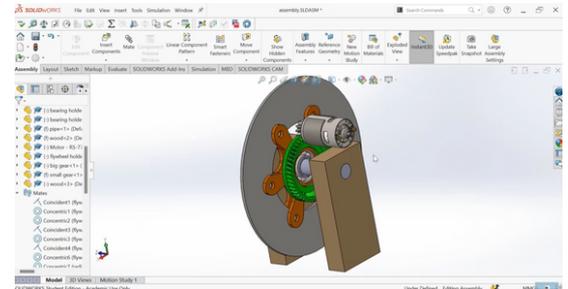
- Manually tracked RPM, measured energy transfer and identified loss contributors like friction and generator inefficiencies. Some future improvements include using **magnetic bearings**, BLDC motor and a better DC-DC converter for stable output voltage.

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.



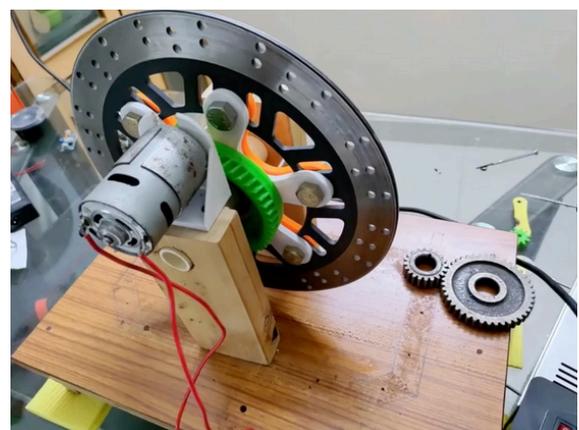
Performed basic physics calculations and understood theory behind flywheel batteries



CAD model in SolidWorks



Flywheel (motorcycle brake disk) with herringbone gears



Final setup of the FESS