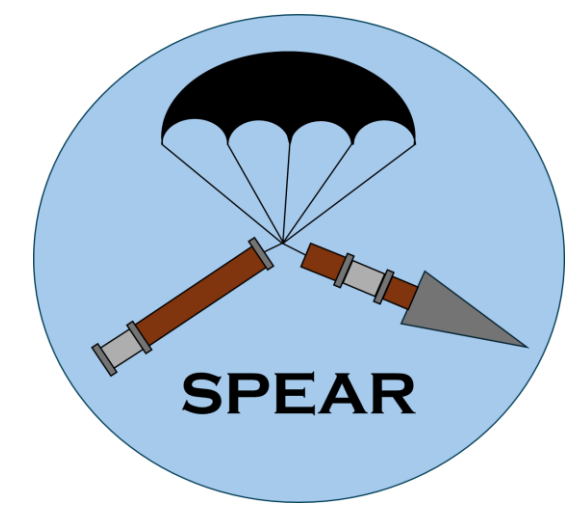
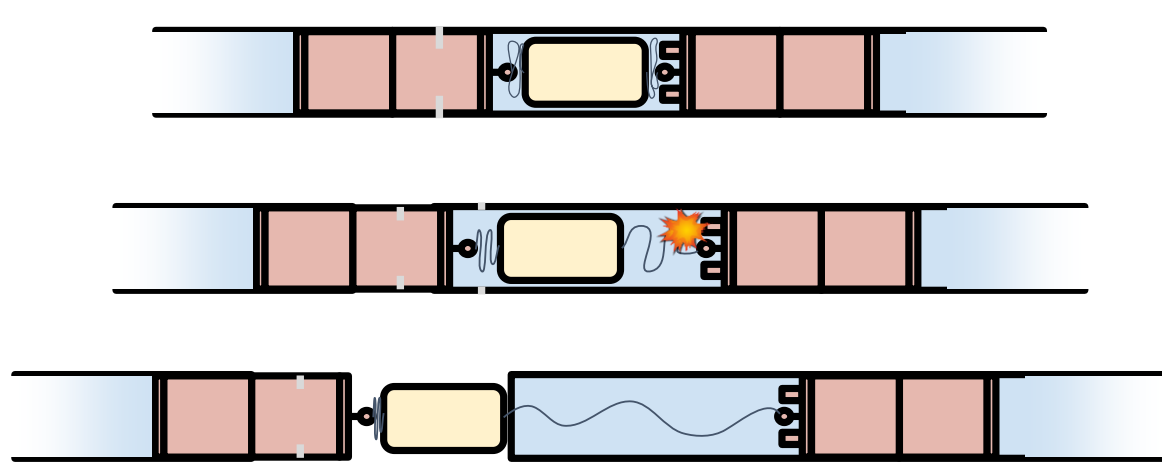


Model rocketry is becoming increasingly popular, but traditional parachute deployment systems rely on explosive black powder charges which introduce safety and handling concerns. SPEAR addresses these issues by replacing pyrotechnics with a reusable lead screw mechanism that gently deploys the parachute. The system is safe to handle, easy to ground-test, and compatible with standard hobby rockets. It has been successfully tested on the ground and in the air.



Background

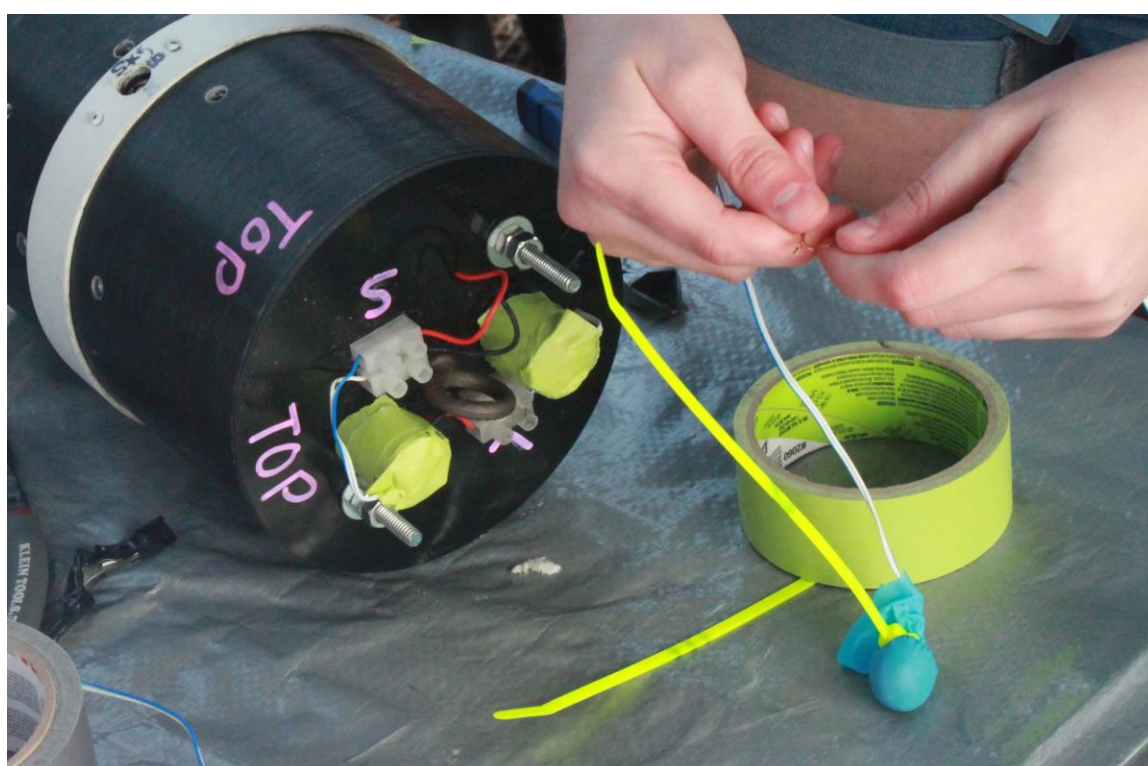


Traditional black powder deployment relies on pressure from a controlled explosion to shear retention pins and deploy a parachute. While simple and reliable, this method has several major drawbacks:

- Requires storing and handling energetic materials
- Consumes shear pins and black powder each use
- Subjects airframe to high pressures and shock forces

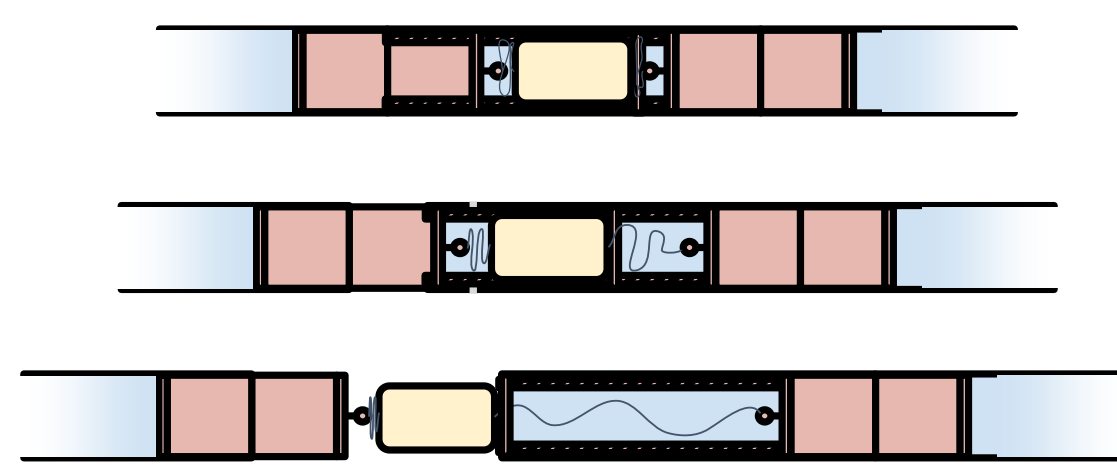


Ejection Charge Measurement

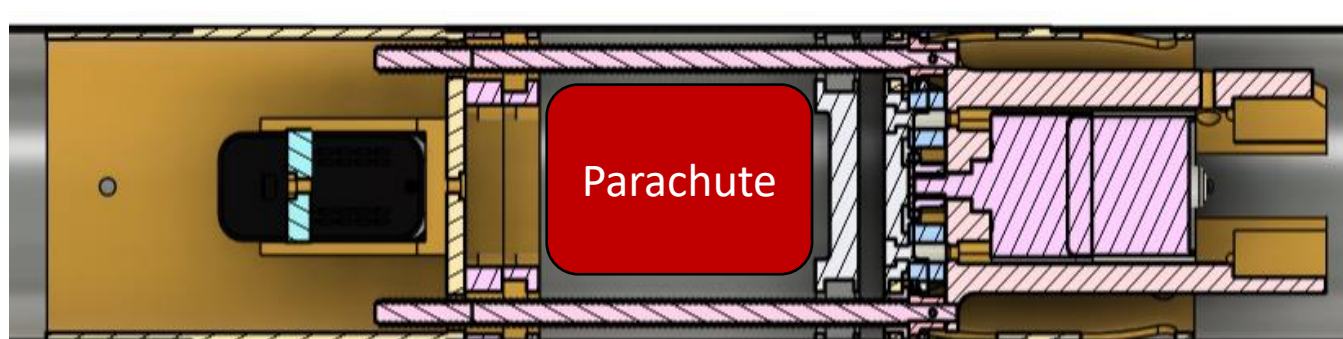


Ejection Charge Installation

Design



SPEAR replaces traditional black powder charges with a self-contained, motor-driven lead screw mechanism. When preparing for launch, the 12V DC motor rotates two ACME lead screws, building mechanical preload that retains the sections during ascent. At apogee, a barometric altimeter triggers the motor to reverse direction, separating the airframe sections and deploying the parachute.



The system was designed to fit a 3-inch diameter subscale rocket body with no modifications required. The modular design is scalable to larger diameters, a primary goal for future development.



SPEAR System (Deployed)



SPEAR System (Loaded)

Marketability

According to MarketIntelligence.com, the market for small scale rockets was valued at \$108.17 million USD and will continue to rise to \$272.65 million by 2033. With the modularity and flexibility of the design, SPEAR can thrive in this market.

Testing

At present time, the most recent SPEAR prototype has been tested 15+ times on the ground with zero deployment failures, and twice in-air via a drone drop. Due to a rocket motor failure, a launch attempt was unsuccessful.



Comprehensive Ground Testing



Launch Attempt



Drone Drop Test

Watch a video of our testing here!



Conclusions

- SPEAR successfully addresses the problems with traditional black powder deployment
- Several added benefits including low setup time and built-in zippering prevention
- Compatible with existing hobby rockets in the market

Next Steps

- Implement system in larger diameter rocket
- Optimize system weight and deployment speed
- Begin large-scale manufacturing

	Traditional	SPEAR
Energy Source	Pyrotechnic	LiPo Battery
Ejection Method	Black Powder	DC Motor
Retention Method	Shear Pins	Mechanical Preload
Fireproofing Required?	Yes	No
Setup Time	30 mins	4 mins
Initial Cost	\$100	\$191
Consumable Cost	\$3 per use	\$0
Ejection Force	85 lbf	3.8 lbf
Ejection Pressure	12 psi	0 psi
Ejection Time	0.06 s	3 s
Total Mass	0.6 lb	1.18 lb
Zippering Prevention	External or None	Integrated

Non-Explosive Parachute Deployment System for Model Rockets

