Electromechanical Nose Cone Separation Ring (eNSR) for Deployment of Amateur Rocket Recovery Systems

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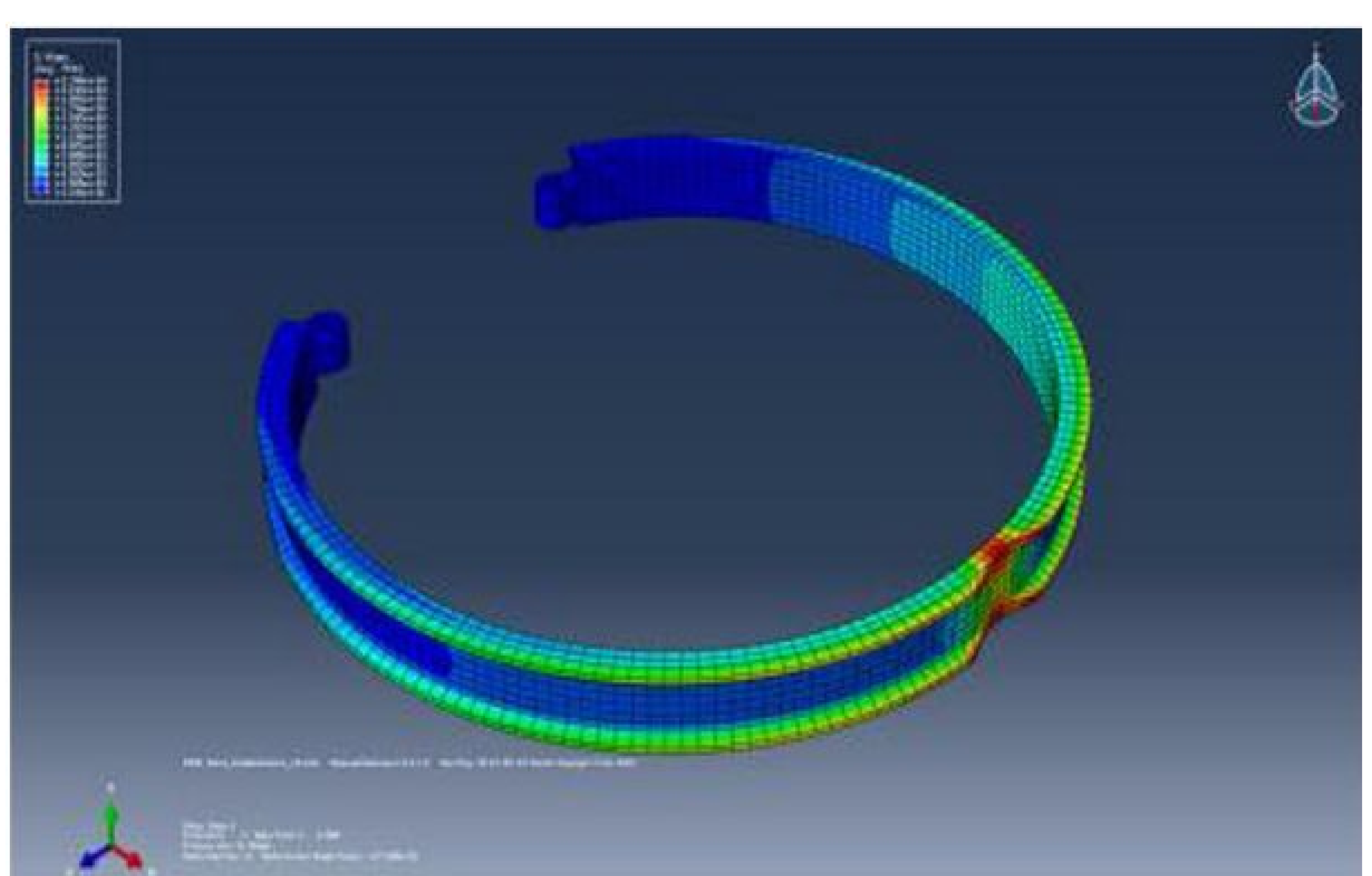
PROBLEM/OPPORTUNITY

The current industry standard nose cone release mechanism in amateur rocketry is a Pyrotechnically Initiated Release Mechanism (P.I.R.M.) which uses a combination of black powder and epoxy. Separation is achieved by detonating the black powder to release the nose cone.

The downfall of the pyrotechnic separation systems is that they cannot be tested without detonating the gunpowder charges, Making it difficult to predict if the system has been prepared correctly before launch. The epoxy commonly used to bind these types of separation rings together takes several hours to cure and can require several days of preparation to adequately assemble a working separation ring.

Often rockets are at several kilometers up when the nosecone is released. This can be well out of view of operators on the ground. A system that provides feedback through the flight computer could give operators advanced warning of system failure.

Figure 1: FEA analysis of the v-band clamp.

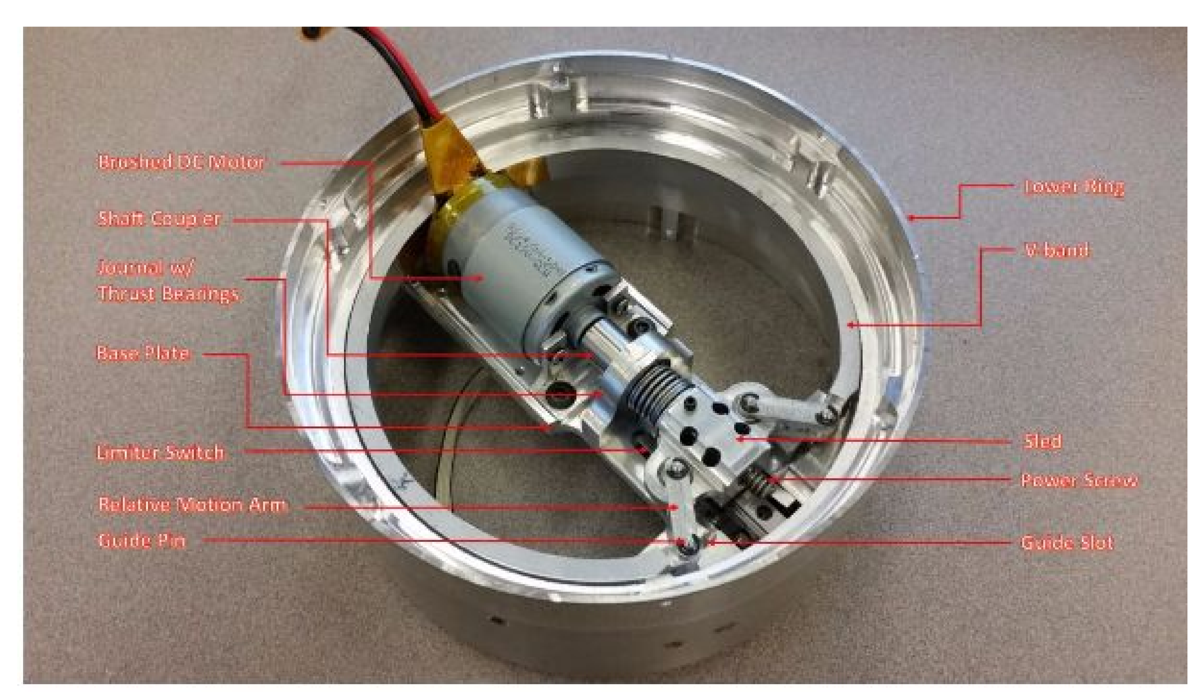


MODEL, OBSERVATIONS, AND LEARNINGS

Drawing inspiration from the $Lightband^{TM}$, a separation system designed by Planetary Systems and used in professional satellite deployment. The eNSR uses a single electric motor and a set of relative motion arms to translate the rotational motion of the motor into the linear motion required to actuate the clamping mechanism.

A flight weight version of the initial prototype was required in the LV3 rocket. To accomplish the required weight reduction a significant amount of material was removed from both the upper and lower rings to eliminate extraneous material that, in the prototype, had been left to streamline the manufacturing process.

Figure 2: Detail of the original eNSR device.



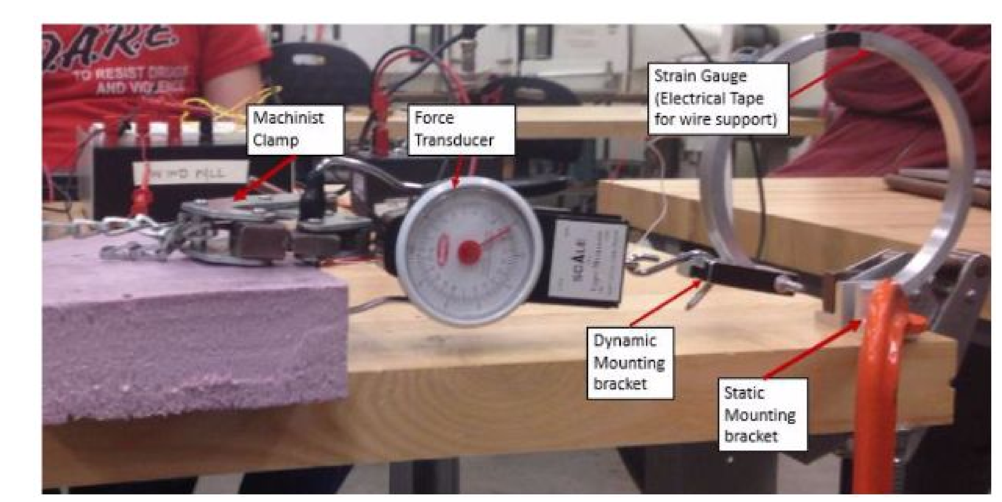
To understand the torque required to actuate the device, and to select an appropriate drive motor, several methods of analysis were employed.

The selected small brushless DC hobby motor, intended for use in quadcopters and model helicopters, provided the necessary speed and torque characteristics. These brushless DC motors are readily available in a wide range of specifications.

RESULTS

The final development of the first flight-ready eNSR is ongoing. Specifically, machining, integration, and testing. The team's goal is to have it ready for launch in October 2016. This will be the first test launch of 3rd generation launch vehicle. The system must be reliable under the extreme stresses experienced in rocket flight while also being as light as safely possible. The system will undergo extensive testing under varying circumstances to simulate flight deployment conditions.

Figure 3: Experimental verification of FEA



Specifically, cyclic loading test should tell us how many times it can be run before failure rate exceeds allowable limits. Actuation under simulated loads shows that the device will function under expected conditions. Simulated rocket flight, free fall off an airplane, tests device functionality in free fall conditions and compatibility with recovery systems deployment.

SPECIAL THANKS

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