National Aeronautics and Space Administration

Sensors

Cord Tension Measurement Device (C-Gauge)

A Non-Invasive Load Cell for Sensing Axial-Loaded Cord Tension

Innovators at the NASA Johnson Space Center (JSC) have developed the C-Gauge, a non-invasive tension measurement device for axial loaded cords. Cordage-based flexible structure systems are used by NASA as parachutes and inflatable structures. For engineers to fully design, develop, and test these types of systems, they must understand the tension and loading of the structural components including the load carrying cords. Traditional in-line load cells require cords to be severed and attached to a metallic interface. The C-Gauge attaches to the cord without any severing of the cord and can measure the structural response without affecting the dynamics of the system, providing engineers a non-invasive way to test cordage-based structures with a small, low-profile, and lightweight device. The C-Gauge has a variety of potential applications including, but not limited to, parachutes, inflatable structures, hot air balloons, weather balloons, blimps, sails, and parasails.

BENEFITS

- *Non-invasive solution:* Unlike the traditional systems available on the market, the C-Gauge does not require cords to be severed to measure axial tension, and its small size and low weight does not affect the structural dynamics of a cordage-based system
- *Adaptable device:* C-Gauge can be scaled to larger and smaller sizes to measure larger and smaller load capabilities, dependent on the cord's dimension

APPLICATIONS

- Aerospace
- Consumer goods
- Military
- Parachutes
- Inflatable structures
- Hot air balloons
- High-altitude balloons
- Blimps
- Sails and parasails

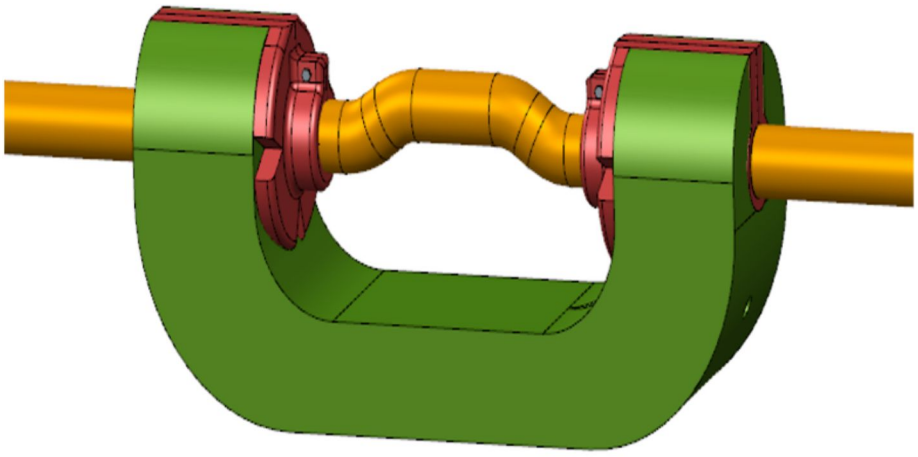
technology solution

THE TECHNOLOGY

The C-Gauge is made of a 3D-printed aluminum body with strain gauges attached to the inner and outer walls of the connecting beam. The legs of the gauge attach firmly to the cord. When the cord is stretched, the tension in the cord goes through the legs and into the beam, causing it to bend. This bending creates a tension and compression stress in the bottom and top surface of the beam, respectively. The strain gauges capture the tension and compression, which are then used to determine the tension in the cord. The use of multiple strain gauges mitigates any torsion loading of the gauge and provides a direct measurement of the axial tension load of the cord.

The C-Gauge is a low-profile, non-invasive system that can be installed onto an existing cord in a system (e.g., the suspension, reefing, or riser lines in a parachute) without the need to remove or re-install the cord. It is small and lightweight and does not add stiffness or weight to the cord and thus does not affect the dynamics of the parachute or the structural response of the system. The C-Gauge can be scaled to larger and smaller sizes to measure larger and smaller load capabilities, dependent on the cord.

The C-Gauge is at a TRL 4 (component and/or breadboard validation in a laboratory environment) and it is now available for your company to license and develop into a commercial product. Please note that NASA does not manufacture products itself for commercial sale.



A drawing of the C-Gauge load cell designed for measuring parachute reefing line tension

PUBLICATIONS

Patent No: 10,816,420

"Non-Invasive Tension Measurement Devices for Parachute Cordage," Douglas A. Litteken & Jared S. Daum, 10/27/2016, https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160012716.pdf

More Information

National Aeronautics and Space Administration

JSC Licensing Manager

Johnson Space Center

2101 NASA Parkway
Houston, TX 77058
281-483-3809
jsc-techtran@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

NP-2020-05-2859-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

MSC-26235-1
MSC-TOPS-83