FAQ's – Frequently Asked Questions for Luna's ODiSI using High Definition Fiber Optic Sensing (HD-FOS)

Q1: What is High Definition Fiber Optic Sensing (HD-FOS)?

High definition fiber optic sensing uses fiber optic cable as a distributed sensor where in effect, every point along the length of fiber is a sensor detecting either strain or temperature change. The sensors are constructed using standard single mode fiber without the need for gratings.

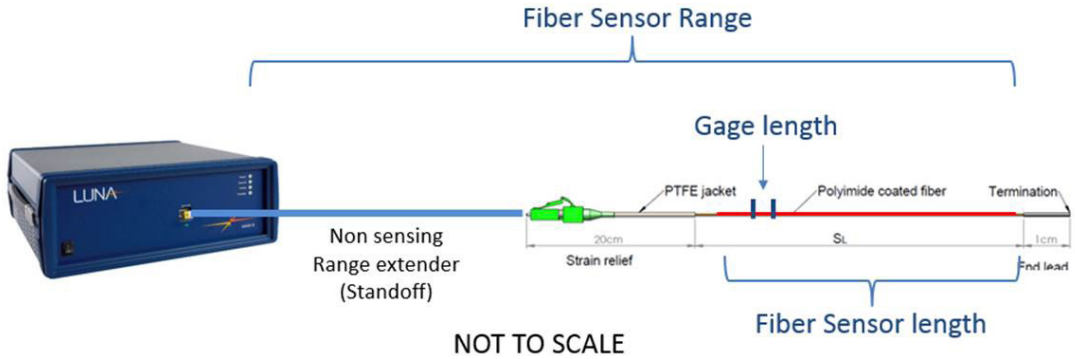
Q2: How does HD-FOS work?

A fiber optic sensor, when illuminated with laser light, has an optical fingerprint and this fingerprint changes in a repeatable and predictable way in proportion to changes in strain or temperature. In the same way that foil gages translates changes in resistance to changes in strain, HD-FOS translates changes in the fingerprint to changes in strain.

Q3: What is fiber sensor length and how is it different from gage length?

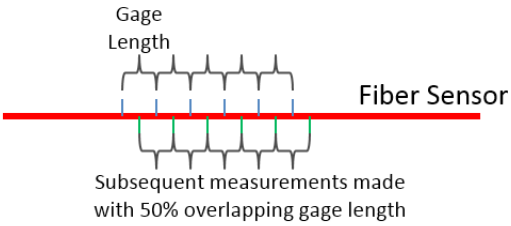
The fiber sensor length is the length of the actual sensor available for making measurements not including the initial section of non-measuring strain relief. This is the length of fiber available for bonding down for strain measurements, or laying out for temperature measurements. The maximum sensor length for an ODiSI-B is 20m.

Each fiber sensor consists of hundreds of gages and these gages have a gage length. For the ODiSI-B, the gage length is preset to either 1.25 mm or 5 mm. For the ODiSI A the gage length is a user adjustable software setting. The HD-FOS gage length is analogous to the gage length of electrical foil gages.



Q4: How many distinct measurements are provided for a given length of sensor?

This depends on the system and is variable for the ODiSI-A since gage lengths and gage spacings are user-defined. For the ODiSI-B, gages are 50% overlapped. Therefore the number of measurements made over a given sensing length is twice the number of gage lengths and the resulting measurement spatial resolution is one half.



Q5: What is the standoff and how does it affect sensor length?

The standoff is a protected length of fiber optic cable that extends the distance between the sensor and interrogator and is not part of the sensor. The standoff length for an ODiSI-A is 10m while that of an ODiSI-B is 50m.

Q6: How is a fiber sensor attached to the test article?

A fiber sensor is attached in a similar fashion as strain gages. The surface is prepped by sanding and cleaning then the fiber is epoxied in place, using the same epoxy used for strain gages.

Q7: What is a mode?

The ODiSI-B can be configured to operate in 4 different modes, each with tradeoffs between maximum sensor length, gage length, and acquisition rate. Mode selection depends on the application. As an example, measurements on composite structures should be carried out with High-Resolution mode due to the inherent non-homogeneity of composite structures.

Q8: How does HD-FOS differ from Fiber Bragg Gratings (FBGs) or are they the same?

Although HD-FOS and FBG's are both distributed fiber optic sensing systems their implementation is very different. The sensors used in an FBG system are custom designed and manufactured while HD-FOS sensors are made from standard unaltered optical fiber. A Bragg grating is an etching at a specific location on the fiber optic cable and this defines the sensor location. Thus in an FBG system the number of sensors and spacing of sensors is determined by the number and location of Bragg gratings etched into the cable whereas with HD-FOS, the entire fiber is a sensor. The location of Bragg gratings cannot be altered in the field and for some FBG systems the number of sensors per fiber is limited. These restrictions do not apply to HD-FOS.

Q9: How would I calibrate the ODiSI and do the sensors need to be calibrated separately?

HD-FOS is a laser-based measurement system and as such has an internal on-board calibration gas cell that ensures each measurement is calibrated to a NIST-traceable standard. It does not require external (re)calibration. For sensors, the calibration from fingerprint change to strain or temperature change has been carried out in the factory, and these values come preinstalled with each sensor.

Q10: What is the maximum strain the ODiSI can measure and can it be used for dynamic fatigue testing as well as static testing?

As indicated by the ODiSI's sampling rates, the system is best suited for static testing and low loading rate dynamic testing. The maximum strain that can be handled by the interrogator is ± 10,000 ustrain for the ODiSI-B and ± 13,000 ustrain for the ODiSI-A.

Q11: How accurate is HD-FOS?

Tests carried out by Luna as well as our customers have shown our systems to be as accurate as traditional strain sensing methods such as foil gages and extensometers, and correlate well with newer strain sensing methods.

Q12: What if I need to use multiple sensors?

The ODiSI can work with eight channel and thirty six channel external fiber optic switches. These are available as separate options.