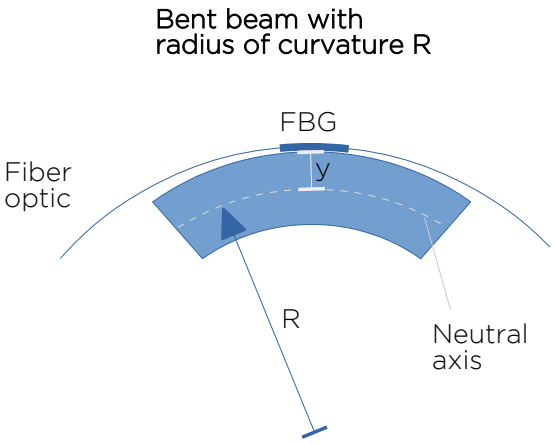
SHAPE SENSING

RECONSTRUCTION OF THE DEFORMATION THROUGH FBG SENSORS



A Bragg grating sensor (FBG) is able to measure the deformation in the point where it is applied, expressed as

$$\epsilon = \frac{\Delta L}{L}$$

where L is the length of the sensor.

In the example shown, the sensor is located at a certain distance y from the neutral axis of a bent beam with radius of curvature R.

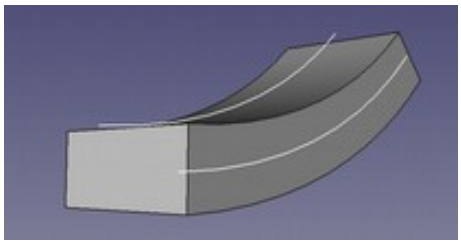
Based on the measurement of the off-axis strain, it is possible to reconstruct the shape of the deformed structure, being

$$\epsilon = \frac{y}{R}$$

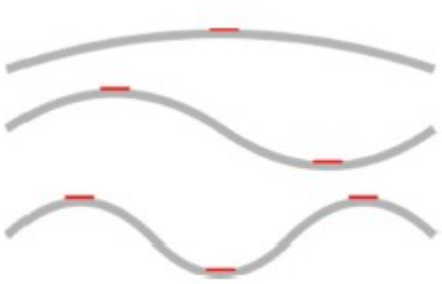
Using a number of sensors on the same optical fiber allows sampling the structure and reconstructing the deformed shape by interpolation between the various measuring points.

In fact, every FBG sensor returns a signal expressed as a "variation of the reflected wavelength" (known as Bragg wavelength λ_B) as a function of the solicitation suffered by the sensor itself. Neglecting here the temperature dependence of λ_B, this means that

$$\Delta \lambda_B = k \epsilon$$



Being this variation positive in case of dilatation and negative in case of compression, positioning the optical fibers in an appropriate manner it is possible to univocally reconstruct the shape of the deformed structure.



By means of an appropriate number of measurement points it is possible to reconstruct the modal shape of the deformed structure.

The acquisition at sufficiently high frequency compared to the size of the structure and to the number of modes that one wants to detect, allows a real time monitoring of the vibrational dynamic effects.