Fibre Optic Shape Sensing for Monitoring of Aerospace Structures

Nazeer, N.

Publication date
2019

Document Version
Final published version

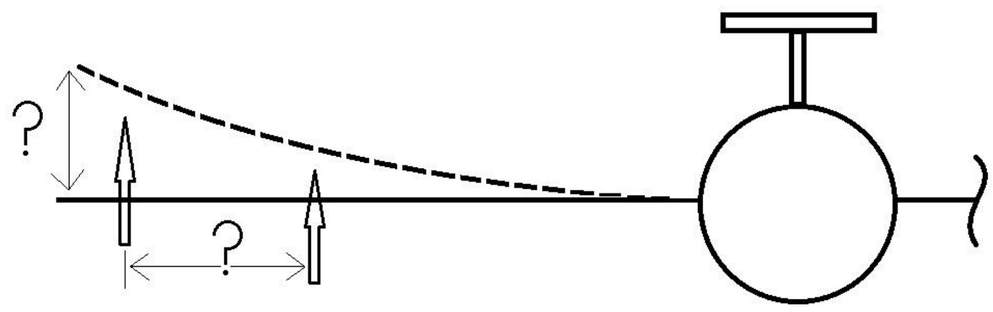
Citation (APA)
Nazeer, N. (2019). *Fibre Optic Shape Sensing for Monitoring of Aerospace Structures*. Poster session presented at PhD Poster Day, Delft, Netherlands.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiVto-41OHtAhXN2KQKHfjcBdsQFjACegQIAxAC&url=https%3A%2F%2Fd1rkab7tlqy5f1.cloudfront.net%2FLR%2FOnderzoek%2FGraduate_School_AE%2FNews%2F2019%2FScientific%2520Event%2FFinal%2520web.pdf&usg=AOvVaw0Vv_zumuknWuc0-8CYGIlO

Fibre Optic Shape Sensing for Monitoring of Aerospace Structures

Nakash Nazeer
ASM
SI&C
Dr. R.M. Groves
Prof.dr.ir. R. Benedictus
N.Nazeer@tudelft.nl

Shape sensing

The need for real-time shape sensing techniques have increased with the advent of morphing capable structures. Current Fibre optic shape sensing methods determine the bending or curvature of the structure but fail to provide information of the location of the load being applied due to which the change in shape had occurred.



This study proposes a novel shape sensor, based on the principles of interferometry and fibre Bragg grating, to simultaneously measure the location of the load applied as well as the magnitude of the structures displacement.

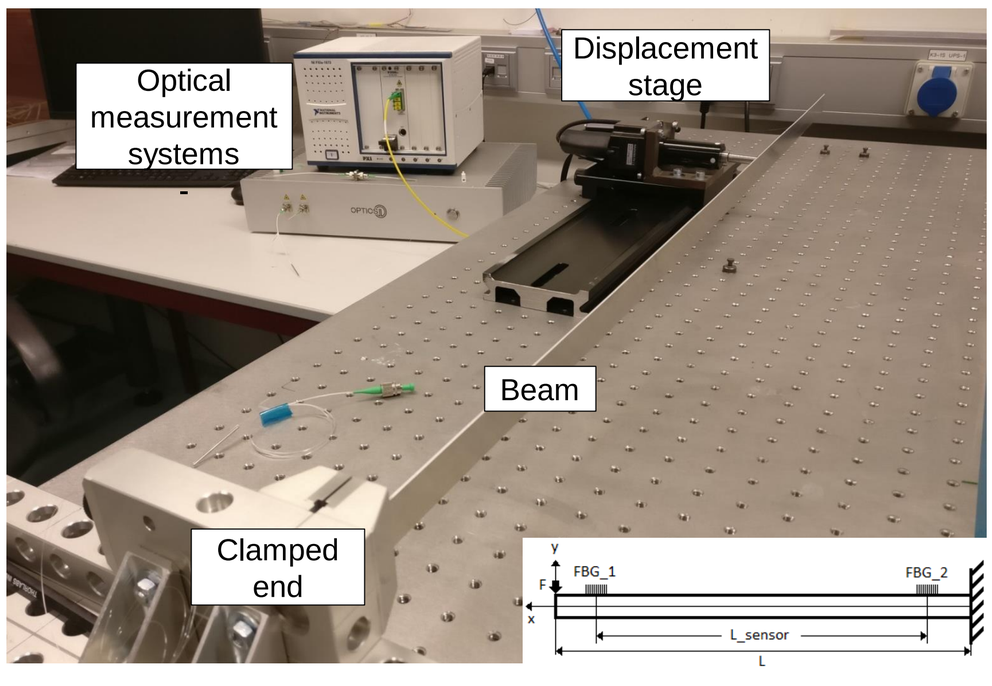
This information would give additional data and insight, hence aiding in better Structural Health Monitoring.

Target structures: Morphing wings and wing sections.

Location of load ?
Magnitude of structural displacement ?

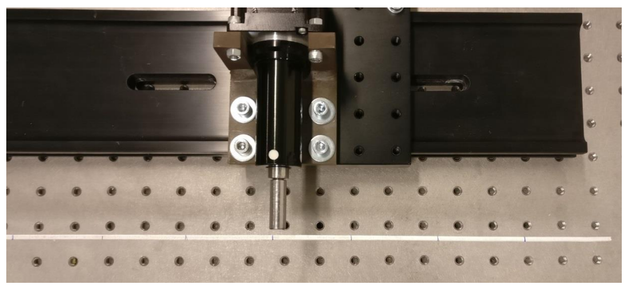
Experiments

The setup consists of an aluminium cantilever beam. A standard single mode fibre containing two fibre Bragg gratings (FBG) was bonded to one side of the beam. Loads were applied through the displacement stage in steps at different locations along the beam.

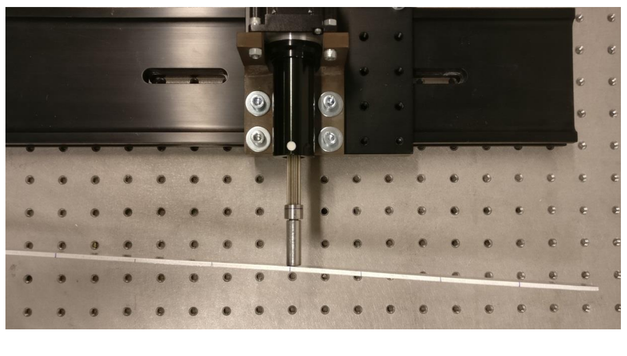


Modelling

Analytical model using known beam theories were developed to assess the accuracy of the experiments as well as incorporating an algorithm to measure the two unknowns.



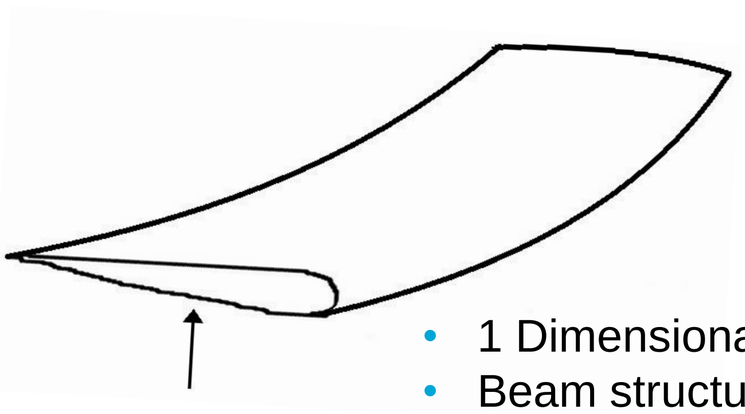
- Unloaded state
- Recording baseline measurements



- Loaded state
- Calibration of the setup and calculation of the location of load and magnitude of displacement.

Findings

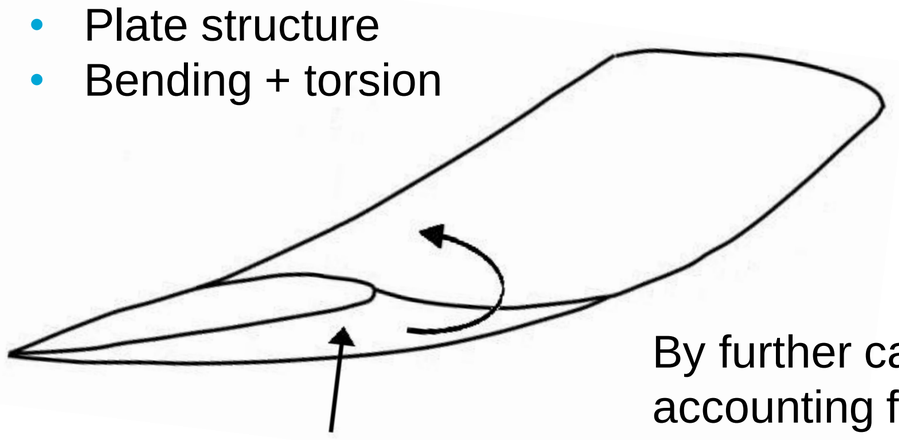
1 Dimensional sensing capability by determining the magnitudes of deflection and location of the displacement along the beam in real-time.



- 1 Dimensional shape sensor
- Beam structure
- Pure bending

Future Work

- 2 Dimensional shape sensor
- Plate structure
- Bending + torsion



By further calibrations and accounting for the errors a higher measurement accuracy can be achieved.

Nazeer N, Groves RM, Benedictus R, Simultaneous position and displacement sensing using two fibre Bragg grating sensors. Submitted to SPIE Smart Structures + Nondestructive Evaluation, Denver, March 2019.