Development of a Fibre Optic Shape Monitoring system for a Morphing Wing Section

Nazeer, Nakash; Groves, Roger

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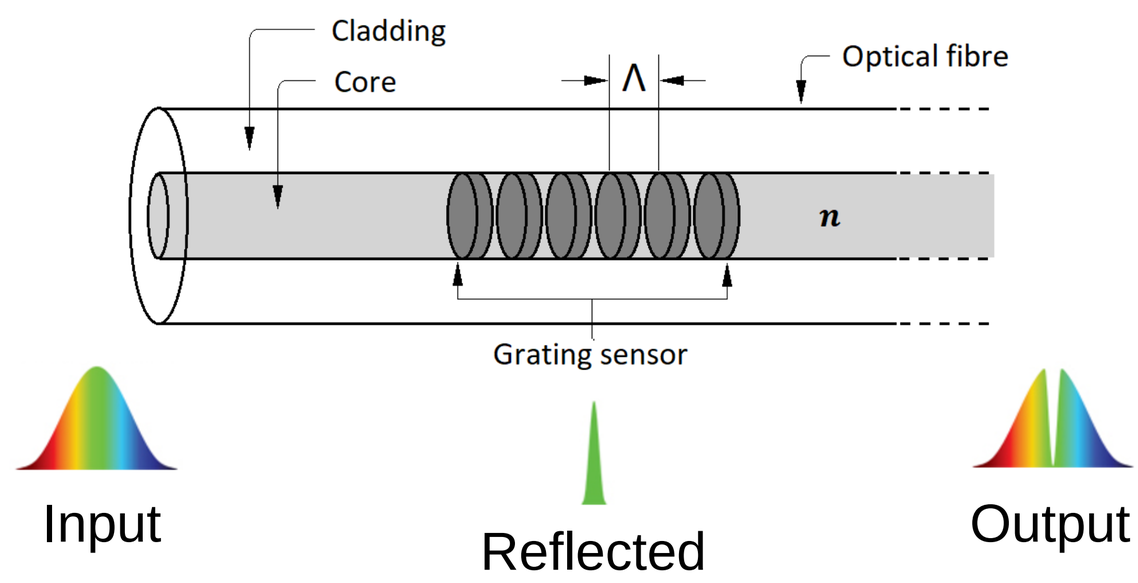
Development of a Fibre Optic Shape Monitoring system for a Morphing Wing Section

Nakash Nazeer (n.nazeer@tudelft.nl), Roger M. Groves (r.m.groves@tudelft.nl)

Fibre Bragg grating (FBG) sensing

The grating in figure forms the sensing region and is capable of modulating the amplitude and phase of incoming light with respect to external disturbances. These gratings are 'written' by exposing the fibre to light with specific wavelengths.



$$\lambda_B = 2n_{eff}\,\Lambda$$

Λ: Periodic spacing
λB: Grating wavelength
$neff$: Core refractive index

On undergoing perturbations, a narrowband of the incident optical field, by successive, coherent scattering from the index variations is reflected with a central wavelength. This wavelength is referred to as Bragg wavelength λ_B. This shift in wavelength is used to measure the strain acting on the fibre.

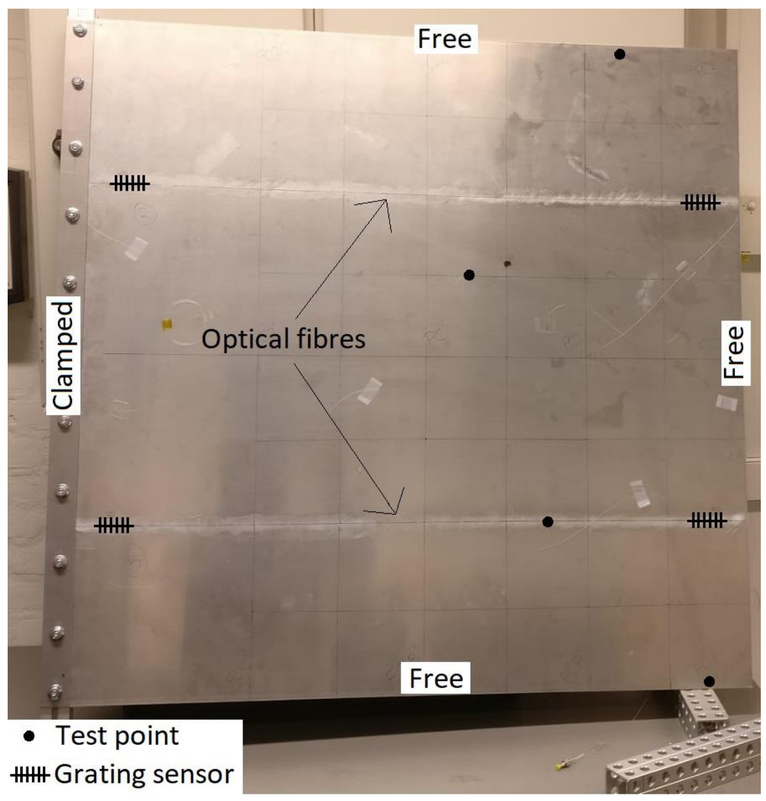
Morphing wings and Structural Health Monitoring (SHM)

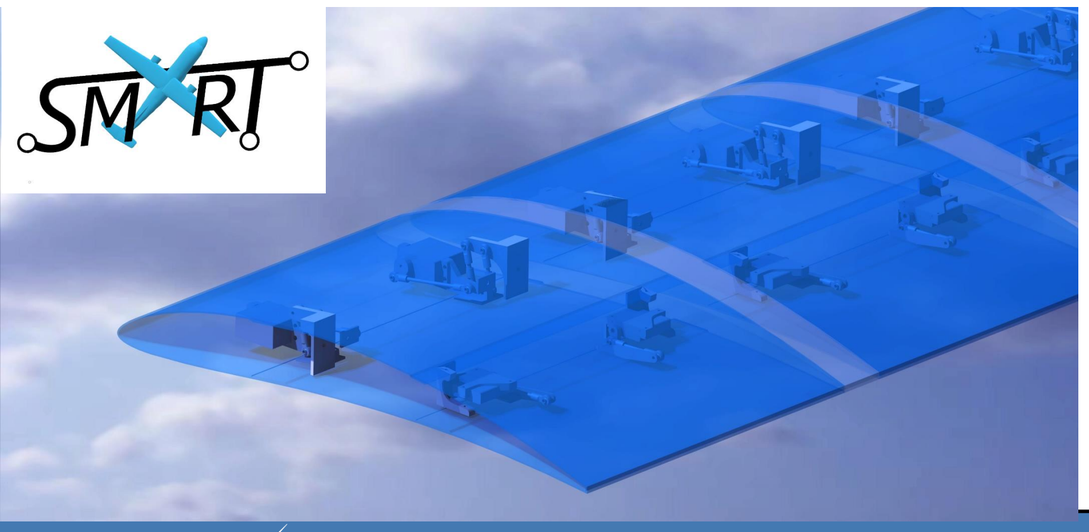
Wings or wing sections capable of changing their shape on-demand are defined as morphing capable. To achieve ideal aerodynamic and structural performance the wing needs to adapt its shape to different flight conditions. That being said, SHM of these structures is of great importance.

Being light weight, highly sensitive and embeddable, optical fibres are perfect for this purpose.

To prove the potential of the developed sensing method, a cantilever panel was tested successfully along with its capability of measuring bending, torsion and location of loads acting on it.

The next step is to incorporate this system in a composite smart-wing. The sensor system would provide critical information on the deflection and shape of its morphing sections hence enhancing its reliability and performance.





This work is part of the smart sensors project that falls under the strategic project SmartX in the Aerospace Structures and Materials department, Faculty of Aerospace Engineering. The project is focussed on the design and development of a smart wing technology.

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