Strain measurement with novel optical fiber sensors: lab characterization and integration on the Swiss Solar Boat v2

Master thesis or semester project at LPAC

Supervision
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Description
In situ deflection measurement of composite materials is currently an engineering challenge. One technique being investigated in both research and academia is the use of multi-dimensional shape sensing using optical fibers mounted directly to the structure. This is now possible thanks to a new optical technology being developed by Kistler called Fiber Segment Interferometry (FSI). The measurements rely on the optical properties of the fiber as they change with the deflection of the structure itself. It is desirable to bring this technology to the state of the art to achieve the following features:

- Ability to perform measurement campaigns to optimize the structure design based on real load cases rather than simulated load cases in a laboratory environment
- Ability to determine the fatigue of composite structures via periodic defined loading tests

The following steps have been identified to progress towards those goals:

- Documentation of state of the art of mounting techniques for optical fibers
- Lab characterization:
  - Trials with various techniques for mounting the fiber (first surface mounted and then embedded)
  - Mechanical testing of the specimen. Benchmarking of the optical fiber measures with others - such as LVDT, DIC, etc- and with FEM predictions
- Boat implementation:
  - Bases on Lina Picasso’s work and the lab characterization, participate to the design of a structural part (most likely candidates: verticals, rudder, foils) with integrated sensors
  - Part production
  - Lab-testing of the part (calibration of the sensor, validation
- Outlook:
  - Field testing once the boat is launched

Depending on the nature of the project (master thesis or semester project), the number of points that can be tackled will of course vary.