Action items for internship:

Optimization of spectral fit algorithms and investigation of polarization-dependent effects on high-precision sensing with pi-shifted FBGs in SM and PM fibers

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Date of issue:	**2023-05-19**
Time period of work:	**23/06/12 – ~23/08/31**

Objectives:
Fiber-optic H2 sensors based on Palladium (Pd) and pi-shifted FBGs in either SM or PM fibers are developed and characterized. Our FBG measurement technique is wavelength-encoded and allows for decoupling of H2 concentration and temperature, requiring high-precision spectral evaluation of two distinctive features in the pi-FBG spectrum.
Those features are fitted with LabView in real-time, allowing collection of wavelengths continuously during H2 calibrations and measurements. The two distinct features currently consist of the notch wavelength and the envelope, which is defined as the left flank wavelength, measured at 50% of the FBGs max. amplitude. While the notch fit, which is a Lorentzian fit, delivers an amplitude-independent fit parameter λ_{notch}, the flank is fitted with a 3rd order polynomial and then interpolated to 50% of the FBG maximum, leading to significant errors due to slight amplitude fluctuations during measurements. *The goal of Task 1 is to achieve a flank wavelength stability of <= 500 fm using our FAZT I4G interrogation unit and a new, amplitude-independent fit of the pi-FBG flank/envelope.*
When this goal has been achieved, a polarization controller including a pol. scrambler will be utilized to "simulate" varying polarization states within the fiber. After development of an experimental setup and writing software for the device interfaces, the new fitting routine can be evaluated for pi-FBGs in SM and PM fibers. *The goal is to support our theory that PM fibers will have more wavelength stability than SM fibers (~200 fm compared to ~700 fm) due to reducing polarization ambiguities at the FBG.*

Task 1: Improvement of flank wavelength stability with new fit techniques / Est. duration: 6 wks
- Getting used to the current problems and techniques of fitting the pi-FBG flank
- Development of solution/s to fit the flank/envelope of the pi-FBG w/o referencing to its amplitude
- Realization of solution/s in LabView
- Test measurements in TEC-stabilized setup
- Discussion of results

Task 2: Polarization dependency on wavelength stability using pi-FBGs in SM/PM fibers / Est. duration: 6 wks
- Design of experimental setup using polarization controller / scrambler
- Development of software interfaces to polarization controller in LabView
- Realization of experiment using SM- and PM-pi-FBGs and new fit routine
- Discussion of results

Task 3 (Optional): Investigation of Pd coatings on wavelength stability at different temp. / Est. duration: 6 wks

Software:
- MATLAB, LabView, Origin, MS Office, etc.

Results:
- Presentation of results in regular project and lab meetings
- Project summary (e.g., technical notes, etc.)
- Data package (e.g., project summary, documents, software, drawings, data, etc.)