1. Introduction

This document will introduce and characterize the performance of a new depolarized laser option for si155 and si255 interrogators. This features is built internal to each instrument, adds no additional volume or power consumption, requires no tradeoff in measurement speed, wavelength range, or accuracy, and results in depolarized measurements for all instrumentation channels.

2. Motivation

The swept wavelength laser architecture brings many intrinsic advantages to optical sensing applications, many of which have been optimized in the si155 and si255 Optical Sensing Interrogator instruments, namely: wide 160nm wavelength range, up to 4 or 16 parallel channel detection with simultaneous 1kHz acquisition rates, high optical resolution, and NIST traceable on-board wavelength referencing. However, in the past many application spaces were unable to benefit from this architecture due to an incompatibility between the birefringence of certain optical sensors and the polarization states of the swept wavelength lasers. This note introduces and demonstrates the effectiveness of a new depolarized laser option that eliminates this incompatibility, bringing the advantages of swept wavelength technology to a vast array of new application spaces.

3. Source Characterization

The following two plots demonstrate the effectiveness of the passive depolarizer in dramatically reducing the degree of polarization (DOP) of the swept wavelength source.

Figure 3.1 shows a time-varying trace of the swept laser degree of polarization. In this plot, the x axis Time (cnts) directly corresponds to the wavelength of the laser, spanning a 120 nm range from 1500 to 1620 nm. The red DOP traces shows how the laser DOP changes as a function of wavelength and can vary from as little as 5% DOP to as high as 90% DOP or more. If measurements are made on birefringent sensors at any of the wavelengths with a strong DOP, those measurements may show a degree of polarization sensitivity.

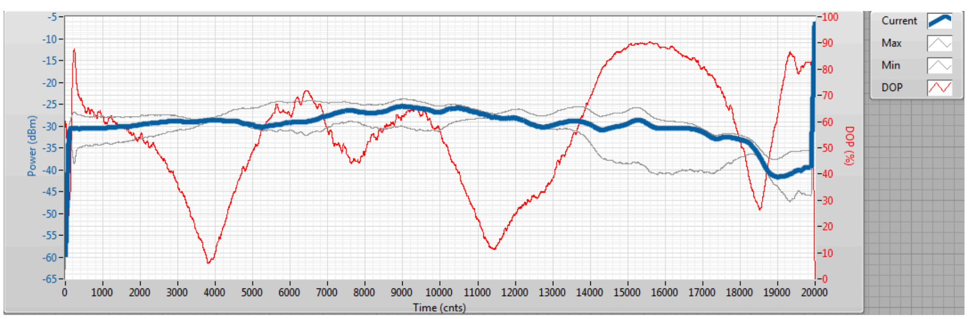

Figure 3.1. Swept laser DOP (red) as function of wavelength (time)

Figure 3.2 shows the same time-varying trace of laser DOP, this time with a depolarized laser. It can be seen that within the operating wavelength range (approximately counts 2000 – 18000) the source DOP has been dramatically reduced, to a DOP of 5% or less. The next section will illustrate the sensor measurement benefits of this low DOP.

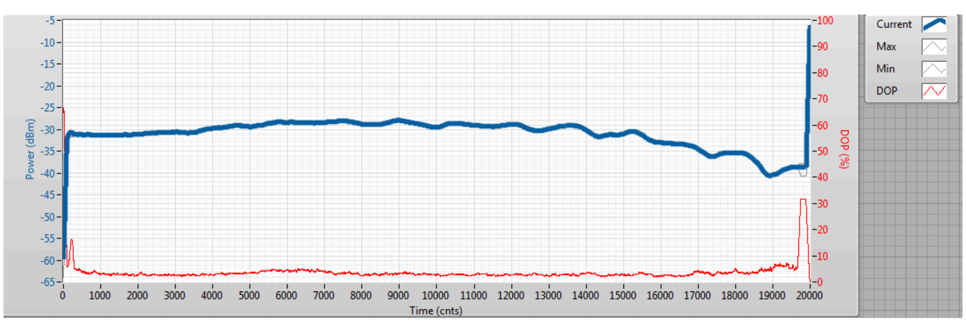

Figure 3.2. Depolarized swept laser DOP (red) as a function of wavelength (time)

4. Sensor Measurement

Figure 4.1 shows an si255 spectral trace of a 16 FBG array (left image) and a time varying plot of the second sensor of the FBG array (right image). During the time that the time varying data was collected, the incoming polarization to the sensor array was modulated with a fiber polarization controller. The combination of sensor birefringence, uncontrolled swept laser DOP, and varying fiber position resulting in a wavelength measurement variation of approximately 20 pm or so. For different combinations of source DOP, sensor birefringence, and fiber manipulation, these wavelength variations can be as low as under 1 pm or as high as over 100 pm.

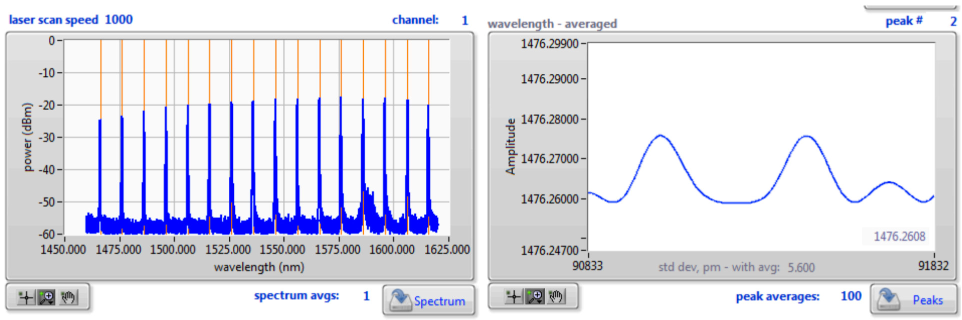

Figure 4.1. Birefringent FBG measurement with uncontrolled swept laser DOP. > 20 pm sensitivity.

Figure 4.2 shows the same sensor array with identical fiber manipulation, this time employing the depolarized laser. Here, it can be seen that the Low DOP of the source results in an elimination of the high polarization sensitivity, with all FBG measurements well under 1 pm. At the extremes, it has been shown that a 100pm FBG sensitivity without the low DOP option will result in a 1-2 pm sensitivity when the low DOP option is applied.

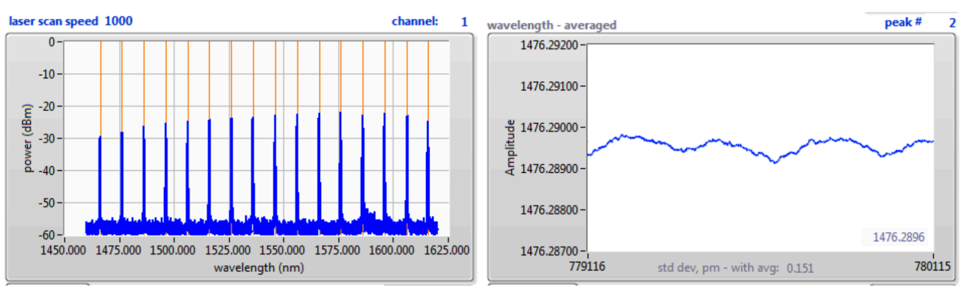

Figure 4.2. Birefringent FBG measurement with low DOP option. < 1 pm sensitivity.

This has been confirmed on both extrinsic sources of birefringence (standard “strip and recoat” or draw tower gratings with applied transverse strains) as well as intrinsic birefringence (such as with femtosecond FBGs and long cavity interferometers).

5. Conclusions

The si155 and si255 Hyperion interrogators can now be equipped with a depolarized laser option, allowing for reliable, accurate, rapid, and highly multiplexable FBG, Fabry-Perot, and other types of sensors measurements without concern for sensor birefringence. All accuracy, wavelength range, channel count, acquisition speed, and repeatability parameters of the standard instrument are maintained with the use of the depolarized laser option. Please contact Micron Optics to discuss the use of this option for your application.

Please forward all questions and inquiries to: sales@micronoptics.com