CLAIMS

1. A coherent receiver for a distributed fiber sensing system, in which a continuous wave laser generates light for propagation down a fiber, with backscattered light provided by a circulator to the coherent receiver, the coherent receiver comprising:

a first polarization beam splitter for splitting a backscattered optical signal from a fiber-under-test into a first polarization input signal and a second polarization input signal;

a beam splitter for splitting a local oscillator (LO) signal into a first LO signal and a second LO signal, the beam splitter being on a planar lightwave circuit (PLC);

a first mixer for mixing the first polarization input signal and the first LO signal for generating a first pair of mixed signals, the first mixer being on the PLC;

a second mixer for mixing the second polarization input signal and the second LO signal for generating a second pair of mixed signals, the second mixer being on the PLC;

a first pair of balanced photodiodes for converting light of the first pair of mixed signals to a first electrical signal;

a second pair of balanced photodiodes for converting light of the second pair of mixed signals to a second electrical signal;

a first pair of variable optical attenuators (VOAs) for equalizing the first pair of signals from the first mixer, the first pair of VOAs being on the PLC, the first pair of VOAs being between the first mixer and the first pair of balanced photodiodes in an optical path of the first pair of signals from the first mixer; and

a second pair of VOAs for equalizing the second pair of signals from the second

mixer, the second pair of VOAs being on the PLC, the second pair of VOAs being between the second mixer and the second pair of balanced photodiodes in an optical path of the second pair of signals from the second mixer.

2. The coherent receiver of claim 1, wherein the first pair of balanced photodiodes and the second pair of balanced photodiodes are mounted to the PLC.

3. The coherent receiver of claim 1 or claim 2, wherein the first polarization beam splitter is on the PLC.

4. The coherent receiver of claim 1 or claim 2, wherein the first polarization beam splitter is external to the PLC.

5. The coherent receiver of any one of the preceding claims, wherein each VOA of the first pair of VOAs and the second pair of VOAs comprises a Mach-Zehnder interferometer with at least one phase shifter.

6. The coherent receiver of claim 5, wherein the phase shifter comprises a thermal phase shifter.

7. The coherent receiver of claim 5, wherein each arm of each Mach-Zehnder interferometer includes a phase shifter.

8. The coherent receiver of claim 5, wherein only one arm of each Mach-Zehnder interferometer includes a phase shifter.

9. The coherent receiver of claim 7 or claim 8, wherein each Mach-Zehnder interferometer includes a first arm and a second arm, and the first arm and the second arm are of unequal lengths.

10. The coherent receiver of claim 5, wherein the first mixer and the second mixer are part of the Mach-Zehnder interferometers.

11. The coherent receiver of any one of the preceding claims, wherein the first mixer and the second mixer comprise 3dB couplers.

12. The coherent receiver of any one of the preceding claims, further comprising a first optical attenuator for attenuating amplitude of the LO signal for presentation to the beam splitter, the first optical attenuator being on the PLC.

13. The coherent receiver of claim 12, wherein the first optical attenuator comprises a variable optical attenuator.

14. The coherent receiver of claim 12, wherein the first optical attenuator comprises a fixed optical attenuator.

15. The coherent receiver of any one of the preceding claims, wherein the beam splitter is a polarization beam splitter.

16. A method of performing distributed fiber sensing, comprising:

generating light from a continuous wave laser;

forming optical pulses using the light from the continuous wave laser;

providing the optical pulses to a fiber-under-test;

receiving back scattered light from the fiber-under-test;

providing the backscattered light as a signal input to a coherent receiver; and

providing the light from the continuous wave laser as a local oscillator input to the coherent receiver;

the coherent receiver including a planar lightwave circuit (PLC) having optical signal paths for separately operating on the signal input and the local oscillator input in a first polarization state and a second polarization state, the operations including mixing with a first mixer the signal input and the local oscillator input in the first polarization state, mixing with a second mixer the signal input and the local oscillator signal in the second polarization state, and equalizing the mixed signals using variable optical attenuators (VOAs) between the first and second mixer and balanced photodiodes.

17. The method of claim 16, wherein the signal input to the coherent receiver is the back scattered light passed through a polarization beam splitter external to the PLC.

18. The method of claim 16 or claim 17, wherein the signal input to the coherent receiver and the local oscillator input to the coherent receiver are in a same polarization state.

19. The method of any one of claims 16 to 18, wherein the operation of equalizing the mixed signals is performed using Mach-Zehnder interferometers with a phase shifter.