Chirped Fiber Bragg Grating

Good morning, everyone, my name is Zhang Hao, now, I’ll start my presentation about “Chirped Fiber Bragg Grating”.

As we know, when a fundamental mode propagates in a single mode fiber with a long distance, especially in a high-bit-rate communication system, the biggest limitation is pulse broadening due to dispersion, which makes it difficult to filter out certain wavelength.

Of course, this also leads to another question: what if we want to compensate the dispersion of SMF?

When we embed a grating with non-uniform periods in the fiber, we can get the chirp. This grating is called a Chirped Fiber Bragg grating (CFBG). Every section of CFBG can be treated as Bragg grating. As we know, when light waves propagate in a medium, they always observed energy conservation and momentum conservation, the vectors of incident wave, grating, and reflected wave satisfy this equation, finally we can get Bragg condition. So, if optical wavelength equals Bragg wavelength, it will reflect out from input port.

Ok, there is a pulse with some different wavelength of ,,, when we launch the pulse into the short-period section of CFBG, optical signals with different frequencies are reflected back at different positions of the CFBG, we can see that short-wavelength light is reflected by the grating first, while long-wavelength light is reflected on the far right of the grating. In other words, the speed of blue-shift component is quick, and the speed of red-shift component is low, they have different velocity, which will cause different time delay, so, the output pulse is broadened.

And if we launched the broadened pulse formed by this situation from the large period of the CFBG, we can see that the red-shift component will be reflected back first when it reaches Bragg condition, and the blue-shift component will be reflected at the right side of the CFBG, therefore, we can recompress or restore the broadened pulse.

Using the CFBG, we can also achieve the optical delay line, as shown in Figure 4. The first CFBG will disperses the pulse, and the pulse will be compressed through the second CFBG. When one of the gratings is stretched, the physical delay between the two gratings is altered and a time delay is introduced.

If you want know more about CFBG, please refer to these two textbooks.