Chapter 5
Conclusions

The high-speed and short pulse laser source has attracted a lot of attention all over the word. In communication system, the high bit rate is very important image transmission in future. The active mode-locked laser is the most efficient method to generate high data rate and ultrashort pulse.

In the Chapter 2, we have demonstrated a new structure of using phase modulated MLF8L. The advantage of Amplitude modulation is to lock the amplitude of longitudinal mode in cavity directly. We have trigger the mode-locked laser of repetition rate of 10 Gb/s, 20 Gb/s, 40 Gb/s and 50 Gb/s with modulation frequency of 10 GHz, 11 GHz, 12 GHz, and 12.5 GHz, respectively. Besides, we utilize time-domain ABCD matrix to budget pulsewidth and chirp parameter of the mode-locked laser cavity. We have known the methods of tuning fitting pulse shape. If we want to tune a similar square wave, we could use modulation frequency of 12.5 GHz and amplitude level of 16.4 dBm at repetition rate of 10 Gb/s. Besides, we have got RMS jitter of 5.147 ps at modulation frequency of 12.5 GHz. The property of this condition is very beneficial to optical transmission system.

In Chapter 3, we have demonstrated a new structure of using phase modulated MLF8L. We have trigger the mode-locked laser of repetition rate of 10 GHz, 20 GHz, 40 GHz and 50 GHz with modulation frequency of 2.4787836 GHz, 2.49171142 GHz, 2.5711934 GHz, and 2.6820745 GHz, respectively. With time-domain ABCD matrix, we budget pulsewidth and chirp parameter of the mode-locked laser cavity. In above experiment, we have known the methods of tuning fitting pulse shape. Besides, we have got RMS jitter of 5.17 ps at modulation frequency of 2.58207560 GHz. The property of this condition is very beneficial to optical transmission system.

In Chapter 4, we have studied the power penalty induced by dispersion and BER performance. If we use the unrepeatered transmission system. In AM fed amplitude modulator transmission system, we can ensure the data rate of 10 Gb/s, 20 Gb/s, 40 Gb/s, and 50 Gb/s can transmit 50 km, 40 km, 35 km, and 30 km, respectively.In AM fed phase modulator transmission system, we can ensure the data rate of 10 Gb/s, 20 Gb/s, 40 Gb/s, and 50 Gb/s can transmit 40 km, 30 km, 30 km, and 25 km, respectively.In FM fed phase modulator transmission system, we can ensure the data rate of 10 Gb/s, 20 Gb/s, 40 Gb/s, and 50 Gb/s can transmit 45 km, 40 km, 35 km, and 30 km, respectively.

If we use the dispersion-managed transmission system, the transmission distance can be large number of increase. In AM fed amplitude modulator transmission system, the data rate of 10 Gb/s can transmit 150 km use the dispersion of DCF. As mentioned early, we know the system has little change of power penalty even the DCF tuning large dispersion value in data rate of 20 Gb/s can transmit 135 km and achieve 10^{-15} at dispersion of DCF of –80 ps/nm. The transmission distance can reach 110 km with data rate of 40 Gb/s. The transmission can reach 105 km with data rate of 50 Gb/s. In AM fed phase modulator transmission system, the data rate of 10 Gb/s can transmit 120 km use the dispersion of DCF. As mentioned early, we know the system has little change of power penalty even the DCF tuning large dispersion value in data rate of 20 Gb/s can transmit 110 km and achieve 10^{-15} at dispersion of DCF of –80 ps/nm. The transmission distance can reach 105 km with data rate of 40 Gb/s. The transmission can reach 100 km with data rate of 50 Gb/s.

In FM fed phase modulator transmission system, the data rate of 10 Gb/s can transmit 135 km use the dispersion of DCF. As mentioned early, we know the system has little change of power penalty even the DCF tuning large dispersion value in data rate of 20 Gb/s can transmit 120 km and achieve 10^{-15} at dispersion of DCF of –80 ps/nm. The transmission distance can reach 105 km with data rate of 40 Gb/s. The transmission can reach 100 km with data rate of 50 Gb/s.

From the eye pattern with 50GHz pulse after transmitted by 100km fiber, we can find the eye pattern is compressed vertically in AM fed amplitude modulator transmission system, so we know the SNR of the transmission system has been reduced. we find the eye pattern is compressed vertically and horizontally at the same time in AM fed phase modulator transmission system, so we know the Timing error of the transmission system has been worse. we find the eye pattern is compressed horizontally in FM fed phase modulator transmission system, so we know the Phase distortion of the transmission system has been reduced.

Comparing the three mode locked laser system, we can find the minmum pulsewidth is 18.4 ps in AM fed amplitude modulator transmission system, the AM fed amplitude modulator transmission system has high SNR, the AM fed phase modulator transmission system has minmum BER 1.13×10^{-15}, the pulse shape of AM fed amplitude modulator transmission system is Sinusoid, the pulse shape of AM fed phase modulator transmission system is Triangle, the pulse shape of FM fed phase modulator transmission system is Sub-square. The RMS jitter of AM fed amplitude modulator transmission system is 5.147 ps. The AM fed amplitude modulator transmission system apply to Insensitive SNR system, The AM fed phase modulator transmission system apply to Insensitive Timing error system,The FM fed phase modulator transmission system apply to Insensitive Phase distortion system.

At last, we list various mode locked laser system of the minmum pulsewidth, Eye pattern shape, bit error rate, pulse shape, RMS jitter, proper system in Table 5-1.

Table 5-1

	AM fed amplitude modulator transmission system	**AM fed phase modulator transmission system**	**FM fed phase modulator transmission system**
Minmum pulsewidth(ps)	18.4	19.2	19.8
SNR	Low	High	Medium
Minmum BER	8.7×10^{-14}	1.13×10^{-15}	1.02×10^{-15}
Pulse shape	Sinusoid	Triangle	Sub-square
RMS jitter(ps)	5.147	5.185	5.174
Proper system	Insensitive SNR	Insensitive Timing error	Insensitive Phase distortion