Radioelectronics and Communications Systems
Vol. 48, No. 6, pp. 24–28, 2005

Izvestiya VUZ. Radioelektronika
Vol. 48, No. 6, pp. 36–43, 2005
UDC 621.396.22:681.327.68

ENHANCEMENT OF SPEED OF FIBER-OPTICAL SYSTEMS FOR INFORMATION TRANSMISSION AND PROCESSING

A. V. Polyakov and S. I. Chubarov

University of Belarus', Minsk

A new method is suggested consisting in timing of a laser by a small (with its amplitude within 0.02–0.18 of the threshold current) harmonic signal. The method is intended for fiber-optical systems of information transmission and processing and permits to diminish fluctuations (limiting the operation speed) of amplitude and time position of information pulses generated by an injection laser. Optimal values are found for the dc bias, coefficient of phase delay between the information signal and the timing signal, and for the timing signal amplitude.

The simple control of the radiation amplitude and frequency in injection lasers (IL) makes them indispensable in high-speed optoelectronic systems of information transmission and processing, where they serve as shapers of information pulse sequences. When the operation speed of such systems approaches several Gbit/s, the noise and dynamic effects in IL begin to limit substantially the rate of information transmission in fiber optical communication lines, and the speed of information recording in optoelectronic dynamic memory devices. The above effects, in combination with other factors, result in instability of change-of-state instants of the threshold decision-making device during the clock period and to an increase in error probability at information reception.

This work is devoted to investigation of techniques for diminishing the impact of fluctuations of radiation power and delay of generation of the IL stimulated radiation with respect to the pumping current on the rate of transmission (writing) of the information flow. The physical nature of the above effects is related to statistics of the processes of carriers' generation and recombination in the laser active domain — together with fluctuations of spontaneous radiation.

A peculiar feature of fiber-optical systems of information transmission and storage is that the information signal represents a sequence of pulses — which is one of the causes of fluctuations of amplitude and time position of pulses radiated by the laser. These fluctuations occur because the laser's state, at the instant of arrival of each next pumping pulse (particularly, the concentration of nonequilibrium carriers), depends on the time elapsed from the moment of radiation of the precedent pulse. This phenomenon is known as the time jitter related to the structure of data transmitted. In addition, another time jitter exists, arising from random variations of radiation generation elements in IL with respect to the pumping current pulse, and depending on spontaneous radiation. As a result, the time of transmission of an information bit may be different. Consequently, when digital signals are perceived by the threshold decision-making device, the error probability grows, which in turn limits the rate of data transmission (recording).

We studied the effectiveness of laser's synchronization by a harmonic signal (SHS) used for diminishing the fluctuation of amplitude and time position of information pulses. The investigations were conducted by the numerical simulation method.

REFERENCES

1. C. R. Mirasso, P. Colet, and S. M. Maxi, IEEE J. of Quantum Electronics, Vol. 29, No. 1, pp. 23–32, 1993.
2. J. C. Cartledge, IEEE J. of Quantum Electronics, Vol. 26, No. 12, pp. 2046–2051, 1990.
3. Y. G. Zhao, IEEE J. of Quantum Electronics, Vol. 28, No. 10, pp. 2009–2015, 1992.
4. L. D. Bakhrakh and A. A. Bliskavitskii, Kvantovaya Elektronika, Vol. 15, No. 5, pp. 879–914, 1988.

23 March 2003