SLW2.3 (Invited)
16:45 – 17:15

Storage capacity of slow-light based on fiber Brillouin amplifiers

Li Zhan
State Key Lab of Advanced Optical Communication Systems and Networks, Department of Physics, Shanghai Jiao Tong University, 800 Dongchuan Rd, Shanghai 200240, China, lizhan@sjtu.edu.cn

Abstract *We study the the storage capacity of slow-light tunable optical buffers based on fiber Brillouin amplifiers (FBA) through theoretical analysis. Gain saturation and pulse broadening are two key factors which limit the buffer capacity. It is shown that the maximum buffer capacity varies with data bit rate.*

Tunable optical buffer is a key component in future all-optical routers, but it is still a bottleneck of all-optical communication network. In the past years, controlling the group velocity of light had been report to be a possible appoach to realize the tunbable buffer. SBS slow-light seems to be the most promising one for its large fractional delay, room-temperature operation, low threshold, possibility working at any wavelength, and compatibility with existing optical communication systems. To date, SBS slow-light experiment extend the delay to several pulse widths by employing cascaded scheme and increase the bandwidth to 12GHz by using a modulated pump, even exceed 25GHz by employing a double pump method.

However, no public reports up to date have evidently shown the delay exceeded one bit, although it exceeded one or two pulse widths in rare experiments by employing short pulses or cascaded scheme. The physics origin of this limitation has not been clarified. The pulse distortion is inevitable in all SBS slow-light shemes, although it can be reduced. Most of the slow-light experiments and theoretical analyses concentrated on single pulse case, in which pulse distortion is not a serious problem. For the real signals, the distortion has a fatal affection on the buffer capability and system performance. However, a detailed theoretical model of SBS slow-light for bit streams has not been proposed yet and the problem of the real storage capacity of the TOB based on FBA remains unsolved.

We study the storage capacity of slow-light tunable optical buffers based on fiber Brillouin amplifiers through theoretical analysis, in which the pulse broadening has been considered. The storage capacity is discussed for two modulation formats: return-to-zero (RZ) and non-return-to-zero (NRZ). Gain saturation and pulse broadening are two key factors that limit the buffer capacity. This is maybe one possible reason why no delay over one bit was reported. It is shown that the maximum buffer capacity varies with data bit rate. We also investigate the optimum data bit rate to achieve the highest storage capacity.

In spite of small buffer capacity, the tunable SBS slow-light buffer can play important roles in some circumstances such as accurate data synchronization and data bit equalization. In addition, we believe similar method can be used to analyze the resonance induced slow-light buffers including stimulated Raman scattering, optical parametric amplification, electromagnetically induced transparency etc.