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NOR gate based on QD-SOA at 250 Gbit/s

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Abstract The performance of all-optical logic NOR gate based on quantum-dot semiconductor optical amplifier (QD-SOA) is simulated. By solving the rate equations of QD-SOAs when incorporated in the arms of a Mach–Zehnder interferometer the performance of NOR gate is numerically investigated. The model takes into account the impact of the amplified spontaneous emission, the input pulse energy and the injection current density on the system's quality factor. Results show that NOR gate using QD-SOA is capable of operating at speeds of 250 Gbit/s with proper quality-factor.

Keywords Optical logic · Quantum dot · Semiconductor optical amplifier · Mach–Zehnder interferometer

1 Introduction

The development of all-optical logic technology is important for a wide range of applications in all optical networks, including high speed all-optical packet routing and optical encryption. An important step in the development of this technology is a demonstration of optical logic elements, which can also operate at high speeds. In recent years, demonstrations of high speed all-optical logic XOR gates using different schemes were reported, including the use of semiconductor laser amplifier loop mirror (SLALOM) (Houbavlis et al. 1999), ultrafast nonlinear interferometer (UNI) (Bintjas et al. 2000) and the semiconductor optical amplifier (SOA) based Mach–Zehnder interferometer (MZI) (Fjelde et al. 2000; Chen et al. 2002). An OR gate has been demonstrated using SOA delayed interferometer (DI) (Dong et al. 2004) as well as a NOR gate using cascaded SOAs (Hamie et al. 2003). Among these approaches,

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