A New Optical Computing Method with Combination of Colored Lights Realizing Balanced Ternary Computation

Yao, Yue

Ternary optical computing is a prospective technology to improve the performance and parallelism of computer systems. It realizes multi-value logic in artificial intelligence as well. This project proposes a novel optical computing method based on the principle that two colors can be combined to make another color. This method uses colors of lights as operands, with color algorithms, to realize arithmetic and logic operations. Previous theoretical works on optical computer haven't touched upon the uses of color as a means of computation. The project's hypothesis is that combination of colored lights can be used to do ternary computation. 7 redundant states of colors should represent 3 numerical values-0, 1, -1. So the project assigned 3 primary colors their values,i.e. red equals 1, blue equals 1 and green equals -2. By the assignment, the project designed a series of color algorithms. Through mathematical analysis, the color algorithms proved correct and led to 4 basic arithmetic and 19,683 logic operations, which supported the hypothesis. Given that the add operation is relatively slow, the author also discusses the optimization on add operation. This computing method presents two main advantages over conventional computing of electronic computers. Using this method, the computing speed is expected to achieve 300GHz with a 1mm-long fiber and a decoder which owns higher speed than existing ones. Secondly, light produces less heat than circuits. Therefore, it will be a tremendously fast and energy-efficient optical computing method with bright future.

Awards Won:

Intel ISEF Best of Category Award of $5,000

First Award of $5,000