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Proc. SPIE / Volume 7185 / New Developments in Methods and Systems I

High-speed low-cost correlator for single molecule fluorescence correlation spectroscopy

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ABSTRACT

REFERENCES (9)

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Fluorescence correlation spectroscopy (FCS) has been extensively applied to study the kinetics and photophysics of molecules as well as interactions between molecules by extracting information from the fluctuation of signals. In particular, single molecule applications of FCS promise the greatest amounts of information. Ideally, one would like to carry out FCS in real-time; however, due to the time-consuming nature of the correlation process, performing the correlation in real-time is totally nontrivial. Generally an expensive hardware correlator or a TCSPC board is required for this purpose. Recently highly-efficient algorithms based on multi-tau method have been proposed to build up a software correlator. In this work, we set forth an innovative algorithm capable of realizing the real-time correlation, without turning to the multi-tau method. This algorithm takes advantage of the low count rate generally existing in the FCS experiments, directly using the time interval between each photon its adjacent photon to efficiently update the correlation function. Based on this efficiency, it is possible to build a low-cost software correlator with just an ordinary counter board. We practically demonstrate the feasibility by setting up this correlator to measure the diffusion motion of rhodamine 6G in water using FCS. The algorithm was validated by duplicating the signal from the photon detector and sending it to both the ordinary counter board with our software correlator and a commercial correlator simultaneously. The perfect coincidence of the correlation curves from these two correlators and the real-time display of the correlation function indicate the validity and practicability of our approach.

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