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Multi-channel digital correlator and hardware simulator for fluorescence correlation spectroscopy, dynamic light scattering and multi-channel photon time stamping[1] ISAAC LESCANO, LLOYD DAVIS, University of Tennessee Space Insititute — In fluorescence correlation spectroscopy and dynamic light scattering, digital correlators acquire the autocorrelation function of detected photons to measure diffusional dynamics of biomolecules and small particles. Multi-channel data from different wavelengths or scattering angles provides increased information for resolving multiple species. Similarly, in single-molecule spectroscopy and in experiments on photon entanglement, there is a need to acquire time stamps of photons from multiple detectors. To enable such advances, we have developed a cost-effective 16-channel correlator, and also a hardware simulator for a 16-channel photon detector for testing digital correlators, each based on a National Instruments R-series reconfigurable digital i/o card. The correlator scans 16 digital inputs each 6.25 ns for photon detector pulses and sends the photon time stamp and channel data to the host PC via a FIFO and 3 DMA channels, allowing $>10^7$ counts/s among the 16 channels. The PC calculates all autocorrelation and cross-correlations for logarithmically spaced delays in a real-time algorithm. The hardware simulator works in reverse: Simulated time stamp and channel data are sent by DMA to the card, which generates TTL pulses for the 16 digital outputs as though they came from 16 real photon detectors.

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