



## Estimation of 'Dead Time' of Transient Digitizer in Raman Lidar

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The Licel transient digitizer used in the Raman Lidar system to record photomultiplier tube (PMT) output can yield the resulting backscattered signal in both analog (in milli volt) and Photon counting (in hertz) modes. The dynamic range of the lidar backscattered signal can be improved by combining the simultaneous measurement of photon counts and voltage analog signal using the slope coefficient [1]. Due to pulse pile-up effect in a photon counter, there is a need for the dead time correction in the photon counts data [2,3]. The dead time corrected signal is obtained using equation 1.

$$c'_k = \frac{c_k}{1 - c_k \tau} \quad (1)$$

Where,  $c'_k$  = dead time corrected photon count data,  $c_k$  = photon counts data and  $\tau$  = system dead time.

The dead time of the transient recorder may vary with the time so, it becomes prominent to periodically estimate the system dead time. In this work, we discuss the method used to estimate the system dead time of the transient recorder of the Raman lidar system installed at National Physical Laboratories' remote atmospheric monitoring station at Palampur, Himachal Pradesh. To accomplish this, we are using an approach of minimizing the root-mean squared difference between the measured analog voltage data and virtual analog voltage data. In this study, we have selected profiles of multiple cloud free days with a temporal resolution of 1 minute and a spatial resolution of 7.5m. Using this multiple profile method, we have observed the system dead time approximated to 4.2 ns which is slightly higher than the value prescribed by the manufacturer. The temporal evolution of the dead time and the influence of signal noise on the value of dead time are also studied. The periodical measurement of the dead time can help in improving the dynamic range of the lidar backscattered signal and obtain the optical properties of aerosol and clouds with more accuracy.

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