5 - 6   Test of the Optimum Lens-target Distance for Pellet Tracking System

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The pellet target system, which is often used in hadronic physics experiments, is an internal target with 4π coverage for reaction productions detection[1]. The pellet will interact with the circulating ion beam perpendicularly in the reaction chamber. The precise determination of the reaction vertex is very helpful for the reconstruction of the events with short lived production particles. The pellet tracking system with other detectors can determine the position of reaction vertex very precisely to an order of ten micrometer[2]. The pellet test station is being constructed at IMP, where the pellet tracking system is being built, and several experiments have been completed in IMP.

The focal length of the camera lens is designed to be 75 mm for M7528-MP of computer Co. But the camera is compacted, the distance between the lens and the CCD is unknown. In order to find a clear-cut edge of pellet's image, the optimum distance between camera lens and pellet must be determined. We make a white line (2 mm in width) on a piece of black paper as a target. The distance between camera lens and target is increased step by step, and photos are taken by the line scan camera. As shown in Fig. 1, there is just one line of pixel in the CCD of the line scan camera. We convert those photos into grayscales, and then we could get several curves from the grayscales. The peak area of the curves is the imaging area of the white line, because the gray value is from 0 (black) to 255 (white). The camera located on the optimum distance (D) can take photos whose image has a clear-cut edge, and the image can be converted a curve whose rise has a larger slope(Fig. 2). The larger the slope is, the clearer the edge gets. So comparing the slopes, 285 mm is the best distance between camera lens and target.
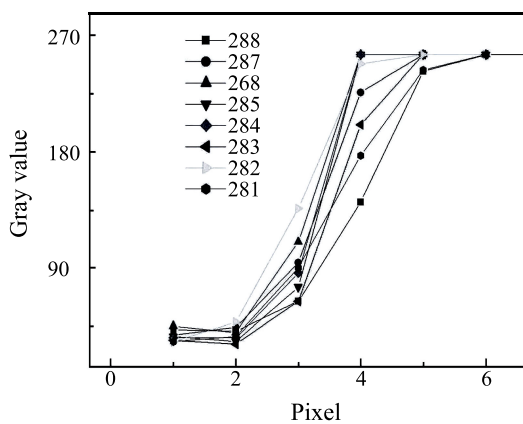

Fig. 1   The rising edge of gray value of white line's left edge as a function of pixel with different distances between the camera and the target.
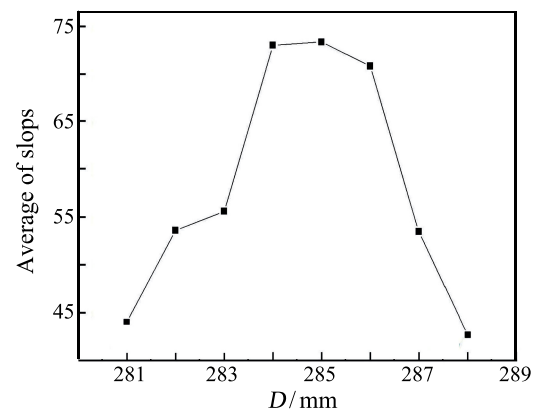
Fig. 2   Measured the slope of the image of a white line as a function of the lens-target distance.

When D=285 mm, the magnification of the images is 0.224. If the diameter of the pellet is 40 μm, the image of the pellet will be 8.96 μm. The size of the camera's pixel is 14 μm, that is, one pellet image is just in one pixel.

References

[1]   Zhankui Li, Xinjuan Rong, Hushan Xu, et al., Science in china, (2009)1047.

[2]   T. Tolba, J. Ritman. MENU, 2007.