



MS Instruments

THE MEASUREMENT OF PROJECTILE PITCH AND YAW

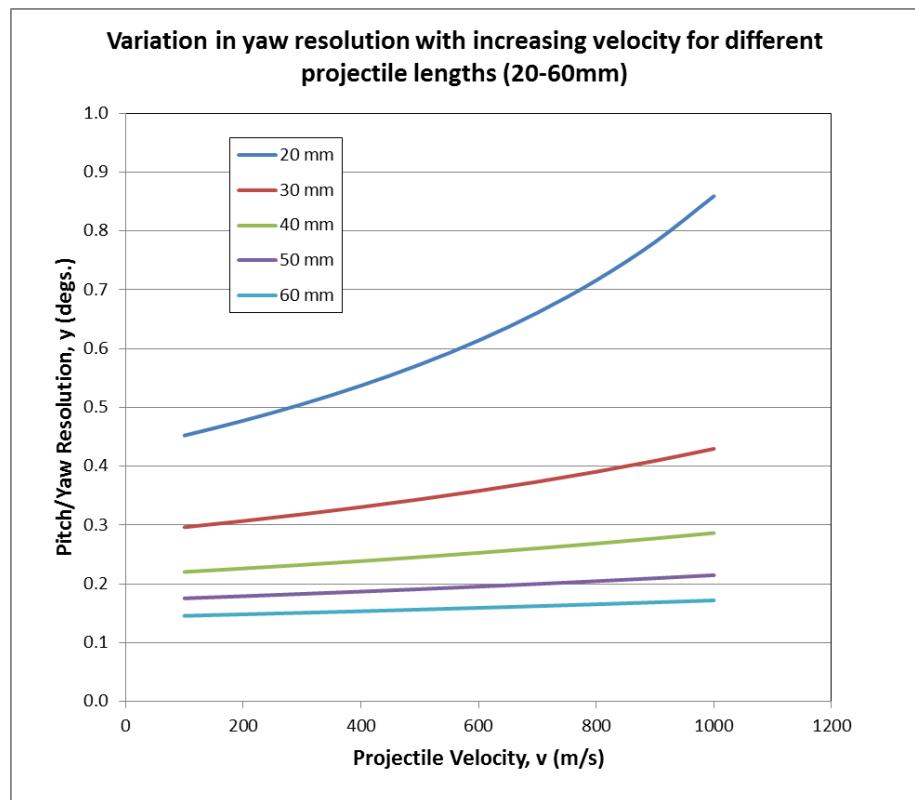
The High-Precision Optical Target type 546 designed and manufactured by MS Instruments LTD, employs two high-resolution line scan cameras that detect the shadow cast by a projectile passing in front of an infrared light strip. The cameras are arranged orthogonally, which enables accurate measurement of the projectile location as it passes through the target plane by finding the shadow's centre.

Note: All calculations below are based on 546 Optical Target with 4k pixel camera and frame rate of 100kHz. We have also assumed that the projectile is near the centre of the typical target detection area (of diameter = 600mm).

Where the camera frame rate is fast enough to capture multiple frames as the projectile passes then it is possible to estimate the YAW by measuring frame by frame shift in the shadow offset for a projectile of known velocity. The projectile velocity can be accurately measured using other MS Instruments products, or by using inter-target arrival times if multiple targets are available.

This is typically the case in Aeroballistic Ranges, where the Optical Target type 546 is installed at multiple positions to enable the tracking of change in pitch in YAW over distance.

Using the above method, the high frame rate and high positional accuracy of the Optical Target type 546 allows pitch and YAW measurement for a range of projectiles of different length and velocity. As a general rule, the YAW resolution improves for longer, slower, projectiles. This trend is illustrated in the figure below, where we can see the resolution approaches 1° for a 20mm projectile beyond 1000m/s.



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