



Applications in ballistics and explosions

Application: Explosions



Fire cracker



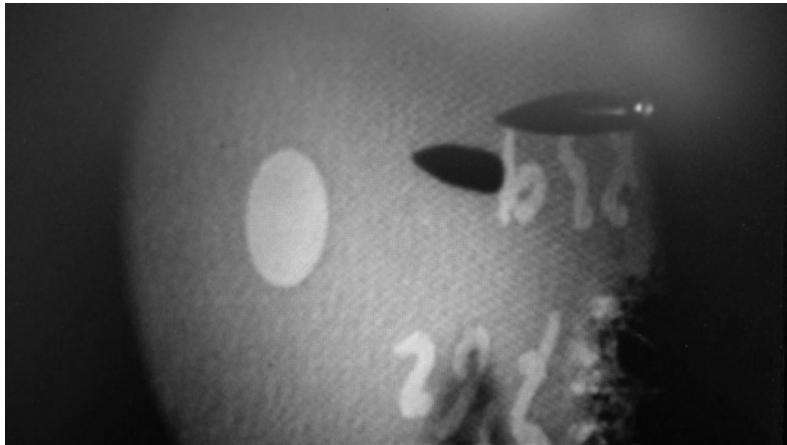
Detonator (at 300.000 fps)

Application: Electrical explosions

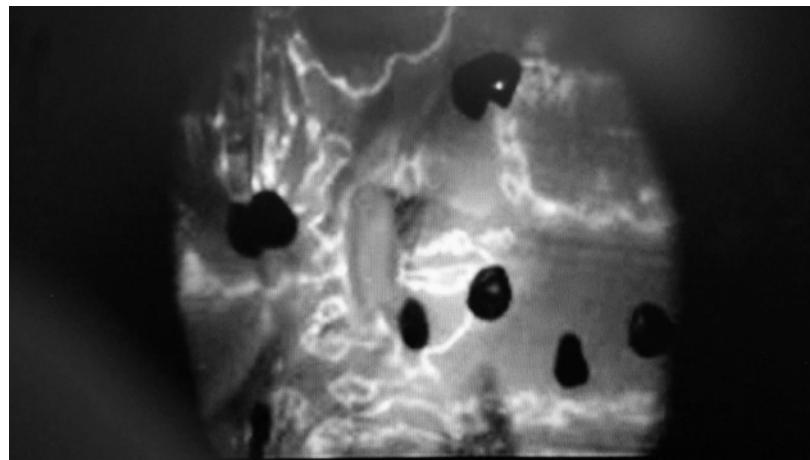


Activated electrical fuse/switch
16A B-curve at 5000 fps

Application: Ballistics



Rifle bullet hitting hard surface



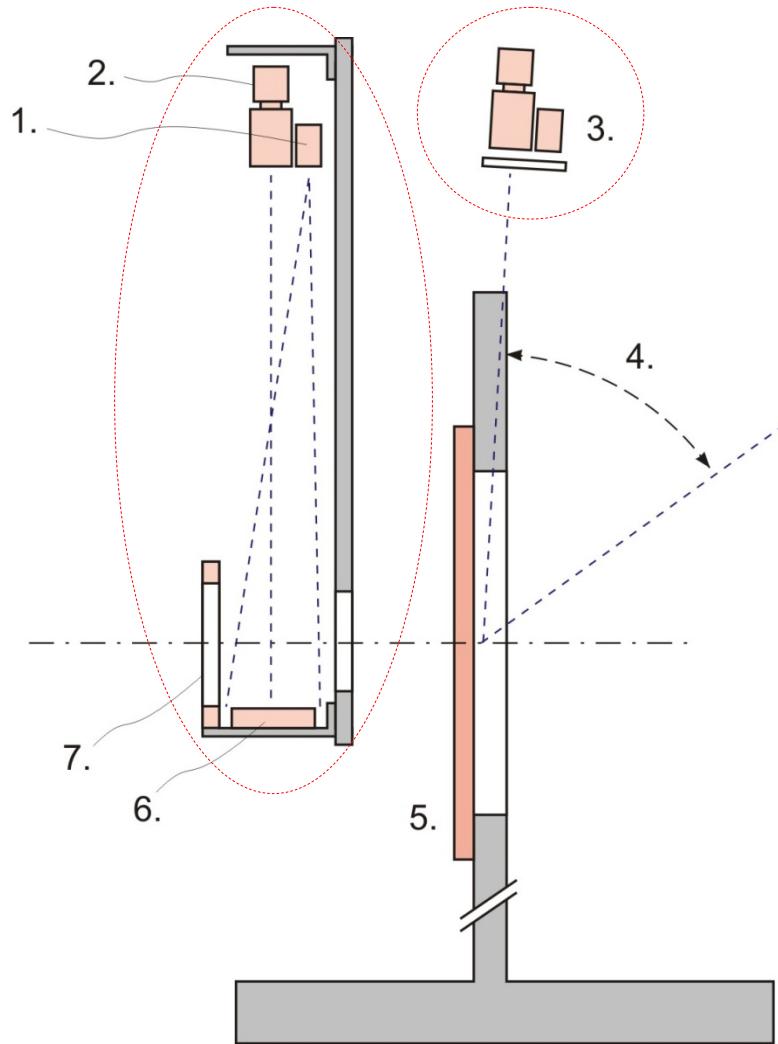
Shotgun bullets hitting textile surface

Measurement systems

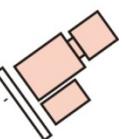
- Provision of components or complete system
- Easy measurement of quantitative information:
 - Yaw angle
 - Velocity before and after collision
 - Deformation and fragmentation
- Ultra-high accuracy
 - Temporal (accurate freezing of the motion)
- Excellent compatibility
 - High speed cameras
 - Machine vision cameras (single or multiple)
 - Multiframe cameras

Measurement equipment options

Visualization device A.



Visualization device B.



Visuzalization device A

1.+2. Illumination and camera

6.+7. Trigger and mirrors

Measuring Yaw-orientation and speed

Visualization device B

3. Illumination and camera

4. Angle towards back of the target

Measuring deformation and resulting speed

Test bench

5. specimen (xy-adjustment)



Images from device A.

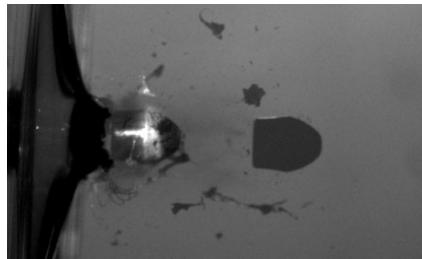
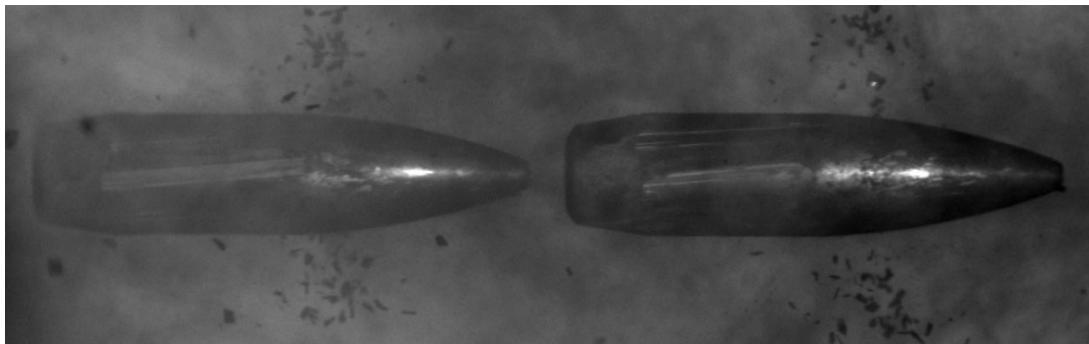


Image from device B.

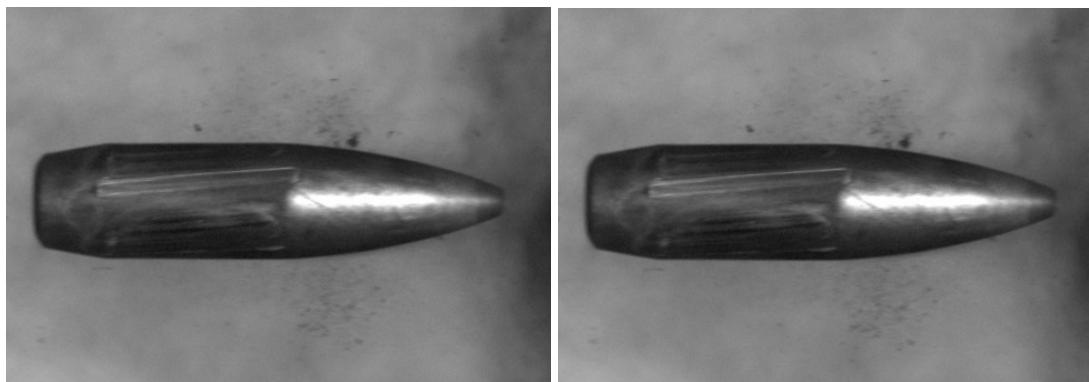
Speed measurement (device A)

The speed is measured by utilizing two laser pulses.



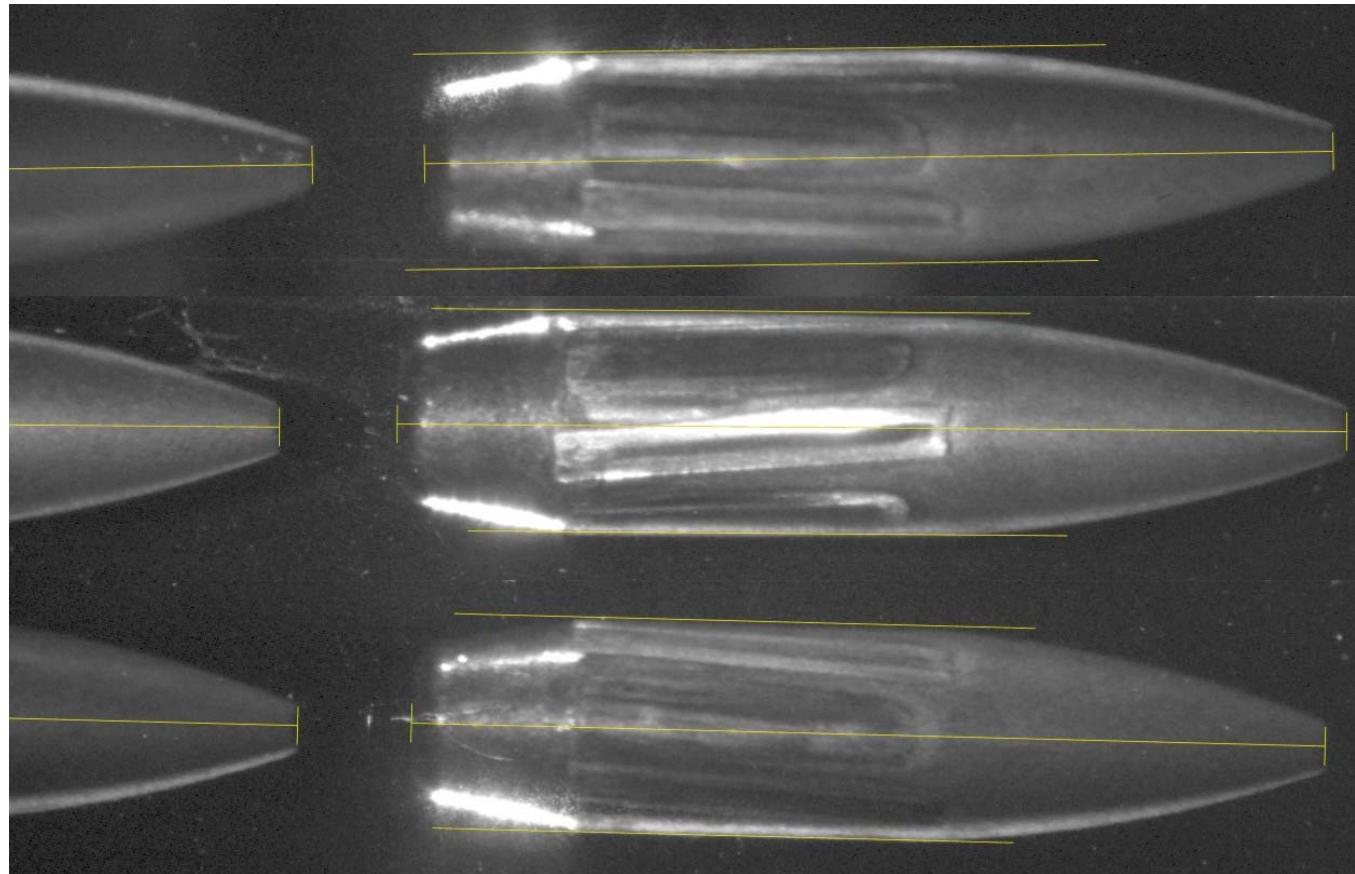
Double frame camera can be utilized as well for visualization
(measurements are taken with normal frame cameras)

→ No multiple exposures in the picture (very accurate images, see below)



Yaw angle measurement (device A)

The Yaw-orientation is measured with the help of a mirror

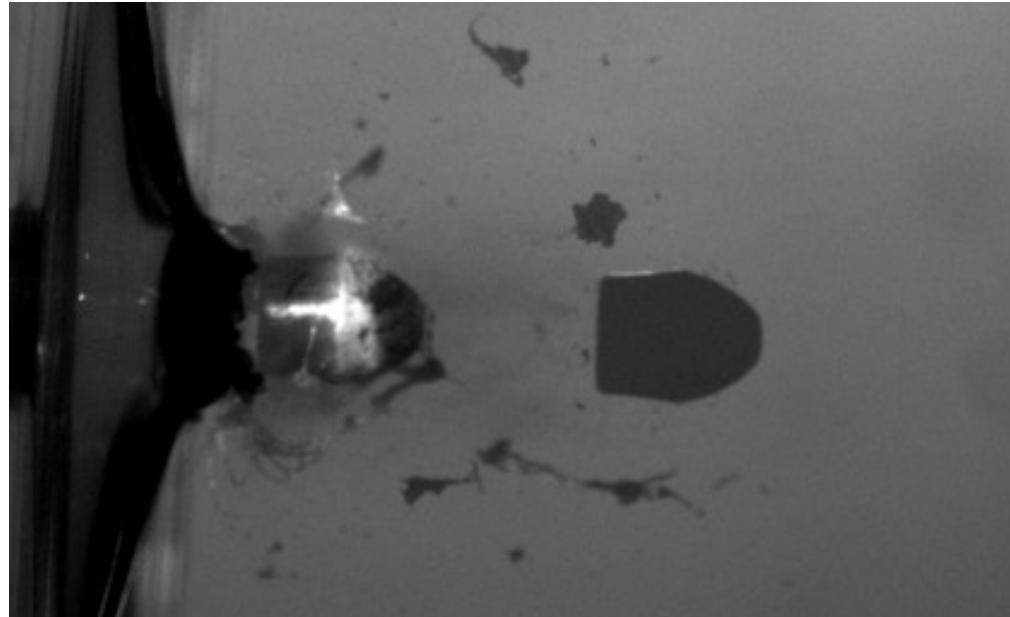


Note: position of mirror is not calibrated. Yaw angle results are estimates.

742 m/s

Resulting speed and deformation (device B)

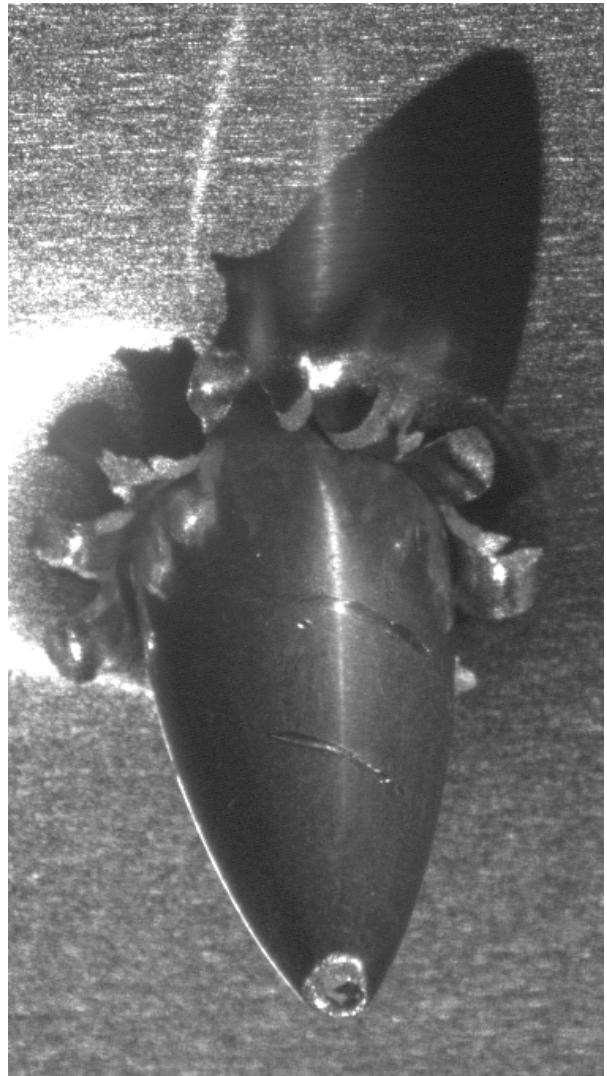
By adjusting the angle of the device towards the target it is possible to take images from the side and from the surface of the specimen.



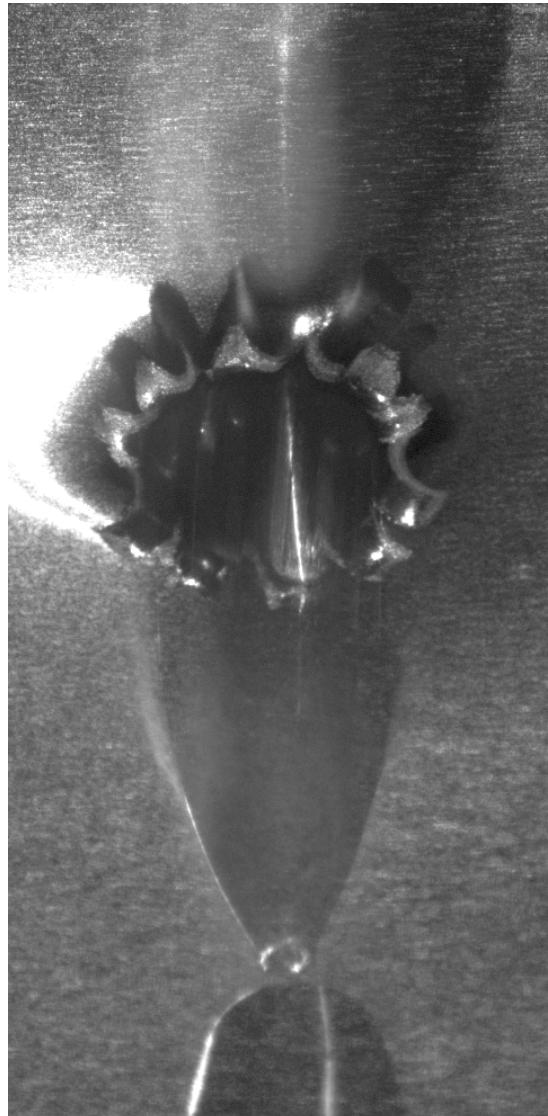
Visualization direction is perpendicular from the bullet trajectory
→ speed (projection)

Back illumination (contour is clearly seen)
→ bullet deformation and fragmentation

Moment after impact (exit)



Single pulse



Double pulse

Visualization and measurement system

Measurement system

- Solution becomes an easy to use routine measurement
- Reliable and durable
- Pictures are shown in the control room
- Easy acquisition of measurement results
- Saving of images (automatically)

Parameters that can be measured:

- Yaw angle of a bullet/fragment
- Speed right before impact
- Resulting speed
- Accurate image of the moment of impact
- Deformation and fragmentation of the bullet after the impact

Hardware and software

- Test bench with xy-adjustment (+-25cm, under 5 mm accuracy, remote usage)
- Protection mechanics and jigs
- Two cameras
- Software (image acquisition and storage, speed and yaw angle calculation)