Universidad Carlos III de Madrid

OO/UC3M/39- OPTICAL SENSOR TO MEASURE THE PROJECTILE VELOCITY

Displays & Photonics Applications Group (GDAF), belonging to *Electronics Technology Department of University Carlos III of Madrid (Spain)*, has designed and implemented a simple, cost-effective, and robust optoelectronic system to measure online the average velocity of a projectile. This system is able to measure velocities ranged between 100m/s and 1200m/s). Potential applications are focused on experimental impact tests on aircraft and spacecraft structures. We are seeking potential collaborations with international/national research centres and enterprises to extent the range of potential applications.

Description and special features

Optoelectronic system to measure projectile velocity online, designed and implemented by Displays & Photonics Applications Group (GDAF) of University Carlos III of Madrid, it is able to measure projectile velocity covering a wide velocity range from subsonic to supersonic from 100m/s to 1200m/s, with velocity measure accuracy less than 1%. Displaying the velocity measure on an LCD mounted in the system or on a remote computer using a serial communication.

The optical system is based on three equidistant optical barriers. Each barrier consists of a beam laser and a photosensor. The whole system uses three laser sources and three photodiodes to form three light lines. Each light line is combined with its own signal-processing circuit, which is managed by a microcontroller. The three optical barriers are on the same level forming a plane. A projectile can be measured only when travelling through this flight plane, therefore the railgun must be positioned perpendicular to the laser barriers.

The projectile velocity is measured through the acquisition of three different signals coming from the crossing of the optical barriers by the projectile during its flight. The detection of these signals by the photosensors and their processing by the microcontroller enables the system to evaluate the average velocity of the projectile. The working principle is as follows. The photodiodes sense when lasers are blocked by the projectile trajectory that is supposed to be perpendicularly incident to the sequential laser barriers.

When the projectile crosses the first optical barrier, the laser beam is blocked and a microcontroller time counter is triggered. Flight times are registered when second and third laser beams are also crossed by the projectile, and then three flight times between laser barriers are determined. Therefore, projectile velocity is calculated as an average, using three distances between barriers and three flight times. This simple method is robust against potential failures. It is able to measure projectile velocity even when an optical barrier is missed by failure in either the optical transmitter or the receptor.

Each time a new measure it is going to be done, the system is auto set up by software, checking and informing the operation status of the optical barriers. The necessary actions are taken by the microcontroller to do the influence of background light in the measured velocity negligible and to keep the system operative in case of barrier failure.

Innovative aspects

The implemented optoelectronic system to measure projectile velocity online is simple, cost-effective, and robust against potential failures of the optical elements and environmental light. It covers a wide velocity range from subsonic to supersonic, from 100 m/s to 1200 m/s, with velocity measure accuracy less than 1%. Velocity measure is displayed on an LCD display mounted in the system or on a remote computer using a serial communication to ensure safety in the experimental impact tests.

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Competitive advantages
Low-cost, robust, wide measurement range and high accuracy system.

Technology Keywords
Sensors / multisensors technology, instrumentation; Laser technology; Equipment, components and electronic circuits; Air transport; Aeronautical technology / avionics; Planes; Helicopters

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