May 1975

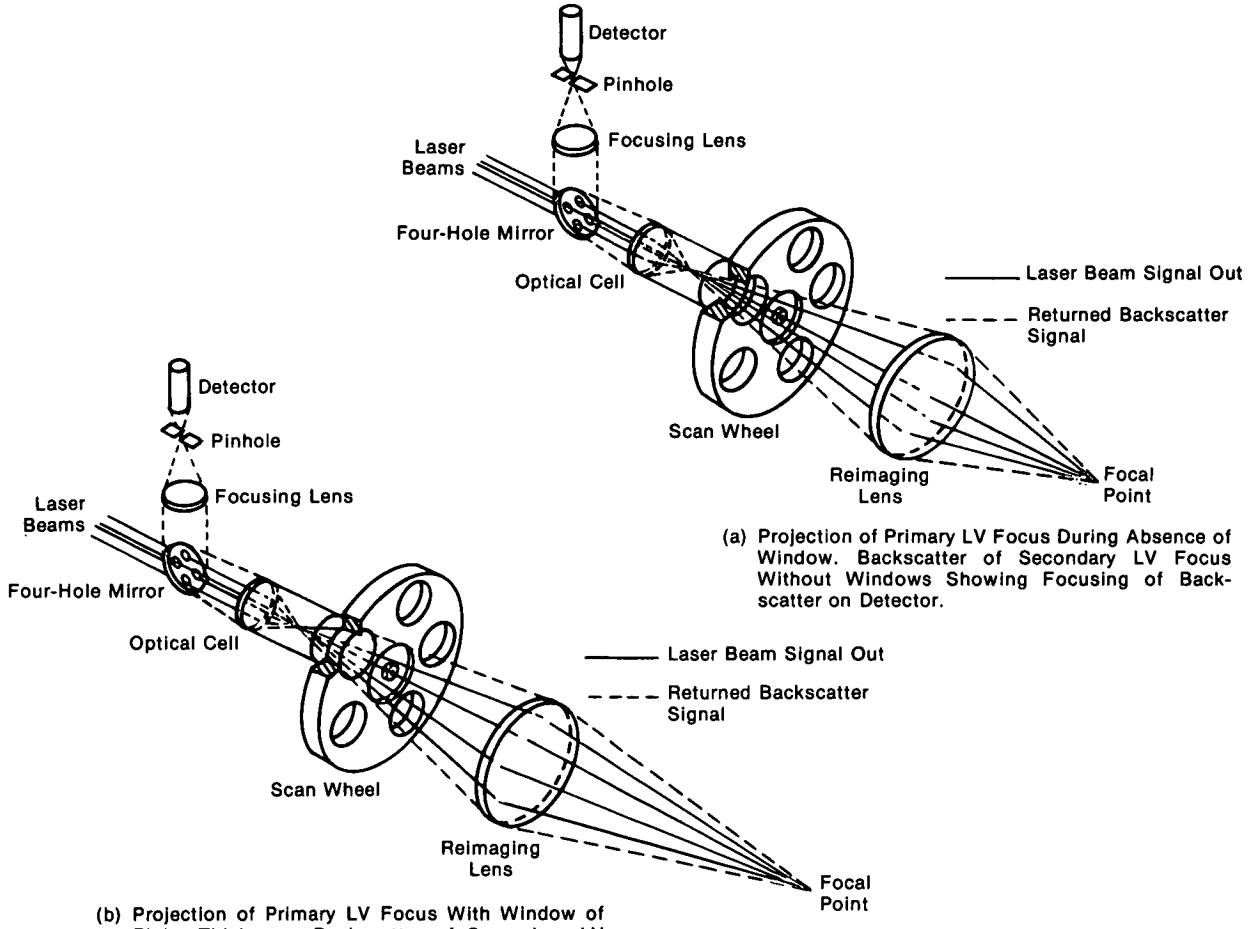
B75-10034

NASA TECH BRIEF

Langley Research Center

Coaxial, Self-Alining Optical Scanning System

A new system provides a fast way to sequentially focus optical energy (light) at preselected points in space. It transmits optical energy to a point in space while at the same time receiving any optical energy generated at that point and then moves on to the next selected point and repeats this transmit-and-receive operation. It fills the need for a system that permits a laser velocimeter (LV) to rapidly scan across a constantly-changing flow field in an aerodynamic test facility such as the wake vortex facility at Langley Research Center.



(a) Projection of Primary LV Focus During Absence of Window. Backscatter of Secondary LV Focus Without Windows Showing Focusing of Backscatter on Detector.

(b) Projection of Primary LV Focus With Window of Finite Thickness. Backscatter of Secondary LV Focus With Windows of Finite Thickness Showing Focusing of Backscatter on Detector.

Optical Scanning System

(continued overleaf)

The vortex flow is scanned or sampled at multiple points by the new optical scanning system (see illustration for a diagram of the system in use). This scanning system consists of a wheel containing various thicknesses of plane parallel windows. The laser beams of the LV system are imaged to a primary LV focus within the dead airspace of an optical cell. The beams emerge from this cell and pass through a window of the scanning wheel. The optical material in the window changes the angle of the divergent beams as they enter the window. The beam angle returns to the entry angle (relative to the normal to the window) when the beams emerge. The angle change produces an apparent shift of the LV focus within the optical cell which is dependent on the window thickness.

When windows of various thicknesses and a constant index of refraction are placed between the primary LV focus and a reimaging optical system, the apparent shift will be imaged as a real shift in a projected secondary LV focus within the test zone. A new secondary LV focus will be observed in the test zone along the optical axis corresponding to each window thickness. The windows are mounted in a wheel so that they can be rapidly placed between the primary focus and the reimaging optics. The scan rate of the secondary LV focus along the optical axis is then equal to the rotational rate of the scanning wheel.

Light scattered from the secondary LV focus within the test zone is collected and reimaged through the same optical path which originally projected the primary LV focus. The backscattered light is reimaged within the optical cell at the primary LV focus and remains stationary even though the secondary focus changes with each new window. This stationary image of the moving secondary focus is possible since the projected and reimaged light have the same optical paths through the plane parallel windows. The stationary reimaged backscattered light, which contains the velocity information, is then collected and focused onto a detector system to complete the scanned LV optical system.

Although windows of a constant thickness and differing indices of refraction can be used in the system, a greater scan range is possible using a constant index of refraction and varying the window thickness. A large scan range can be obtained by magnifying the small apparent shift with the reimaging system. This new scanning technique could be of use in any LV system requiring the high-speed sampling of flows.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Langley Research Center
Mail Stop 139-A
Hampton, Virginia 23665
Reference: B75-10034

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Langley Research Center
Mail Stop 313
Hampton, Virginia 23665

Source: David B. Rhodes
Langley Research Center
(LAR-11711)

Categories: 03 (Physical Sciences)
02 (Electronics Systems)