The Basics of Laser Doppler Anemometry

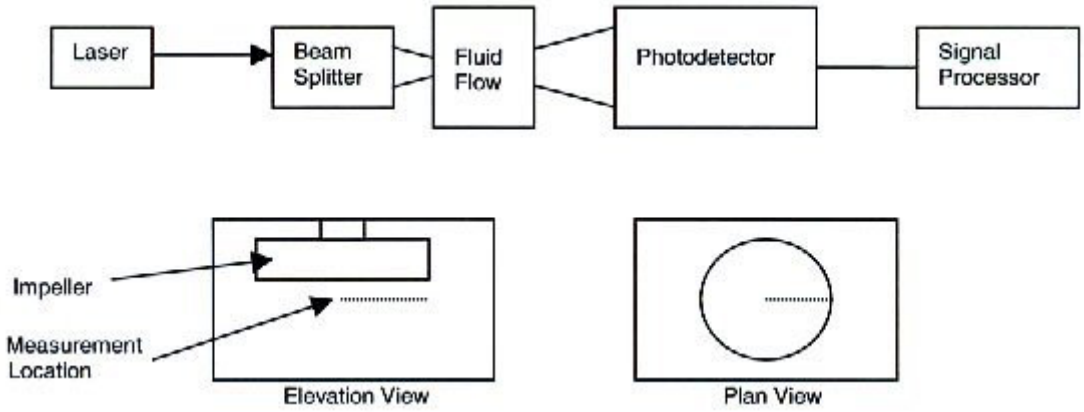
By: David Lee
Applications Engineering, Mixers
Hayward Gordon Ltd.

Hayward Gordon has used Laser Doppler Anemometry (LDA) to help quantify the performance of various mixing hydrofoils by measuring the fluid flow velocities developed by these impellers. LDA is widely recognized as the best technique for measuring fluid flow velocities. Its non-intrusive nature, directional-sensitivity, and measurement accuracy make it ideal for applications with rotating machinery and chemically reacting or high-temperature media.

The basic LDA system consists of:

- a laser
- a beam splitter
- a photodetector
- a signal processor (PC)
- micron-sized tracer particles added to the fluid (a process known as seeding)

The laser is split into two beams and focused at a single point in the flow. When two laser beams with the same wavelength intersect, an interference pattern of bright and dark fringes is formed. As a tracer particle (3-10 μm diameter latex beads) passes through the intersection of two such laser beams, reflected light is scattered from particles in the flow. The scattered light contains a Doppler shift, the Doppler frequency, which is proportional to the velocity component of the particle. The photodetector then collects the scattered light and converts this information to the electrical signal processor. The processor extracts the velocity information and stores it for user analysis.



The velocity measurements are taken just below the impeller at 20 equally spaced points along the impeller's radius with approximately 40,000 reading taken at each of the 20 locations. The mixed medium is normally water and tests are conducted at a number of different impeller speeds.

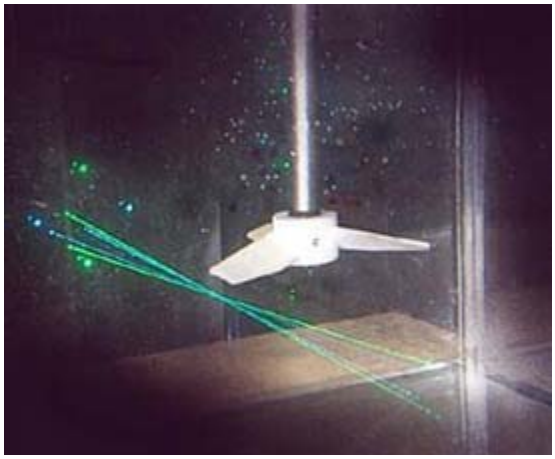


Figure 1: Measuring the flow developed by a 3AL45 Hydrofoil Impeller.

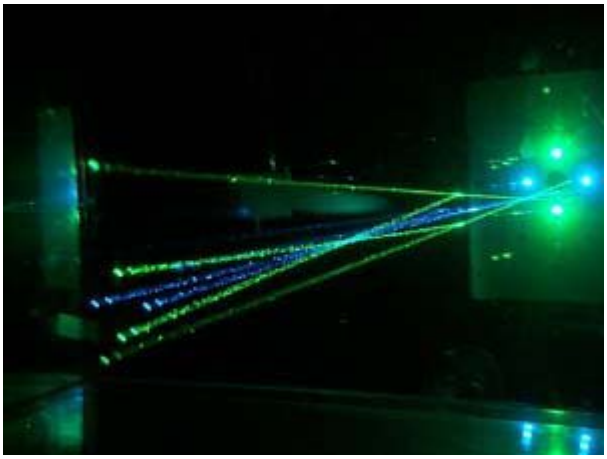


Figure 2: Picture showing intersecting laser beams where velocity measurements are taken.

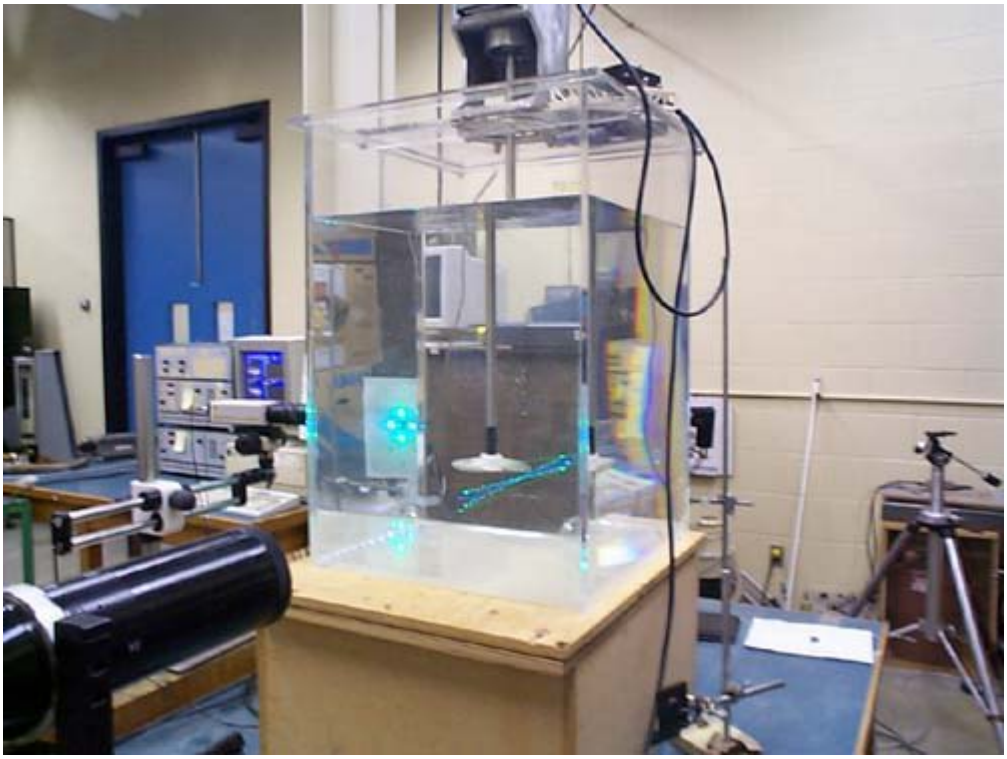


Figure 3: Velocity measurement test rig.