Acceleration and Vibration

Accelerometers that measure or sense acceleration are probably the most ubiquitous devices in all of our human experience. They are present not only in virtually all of our machines from cell phones to automobiles to planes to almost all of our sensing devices. Obviously a general treatment of accelerometers is far beyond the scope of this text. Consequently we confine these brief comments to the use of accelerometers in fluid flow measurements or in their deployment in fluid machinery.

For a variety of reasons, flow experiments frequently benefit from the addition of accelerometers to measure the structural vibration of the structure or of objects immersed in the flow. The reasons include (1) the fact that the flow often interacts with the structure and documentation of this is desirable and (2) the fact that the structural vibration can sometimes effect other measurements, for example those by some types of pressure transducer.

Various types of accelerometers are available: uniaxial accelerometers that measure the acceleration in one direction only and multiaxial accelerometers measure in two or more directions. They come with a range from a few g to hundreds of g and, like transducers, the sensitivity is proportional to the range and so a range should be selected that is consistent with the expected acceleration magnitude. They can also be either static or dynamic and have a frequency response that must be considerably in excess of the frequency of accelerations being measured. For accurate measurement they need to be clamped to the object whose acceleration is to be measured. Most modern accelerometers utilize either a piezoelectric crystal or an internal MEMS device that measures the displacement of a small internal mass. Modern accelerometers can be very small, are quite inexpensive and can therefore be liberally deployed. Considering the fact that accelerometers are relatively inexpensive and fairly easy to install, the author would strongly recommend a comprehensive installation in any fluid flow experiment or installation. Complementary equipment would be high quality signal processing electronics.

In addition, accelerometers are now extensively use to monitor the condition of most fluid machinery including pumps and turbines. These allow continuous monitoring of components like bearings and seals and therefore inform maintenance procedures.