Sheikh Hasina University, Netrokona

Department of Computer Science and Engineering

CSE-2205: Introduction to Mechatronics

Lec-3: Introduction to Mechatronics

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Contents

Sensor Characteristics

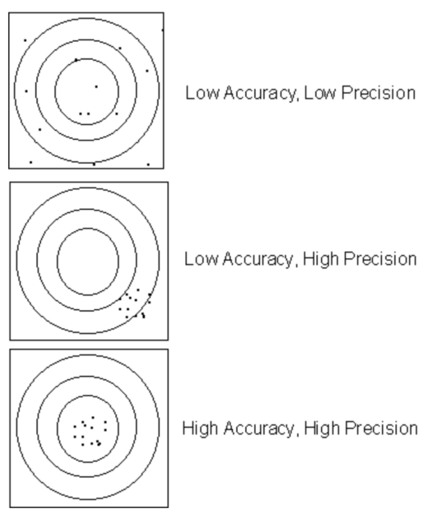
Two other terms are used to describe sensor behavior, and shall be described here. These are accuracy and precision.

Accuracy

The accuracy of a system is the difference between the actual and the measured value. The distinction between accuracy and resolution is important. While resolution is the smallest change in measurement value that can be indicated, the accuracy is determined by the actual indication of the sensor and the real value of the measured entity. Thus while resolution depends solely on the sensor hardware, the accuracy is a function of the sensor hardware as well as the measurement environment and other extraneous factors that modify the sensor behavior.

Precision

The precision is a statistical measure. It is usually indicated by the standard deviation (or variance) of a set of readings of the sensor for the same input. The distinction between accuracy and precision is clarified by the following figure.



Static Characteristics:

Static characteristics refer to the attributes or behaviors of a system, device, or component when it has reached a steady-state condition or is not undergoing any change with respect to time.

The static accuracy of a sensor indicates how much the sensor signal correctly represents the measured quantity after it stabilizes (i.e. beyond the transient period.) Important **static characteristics** of sensors include sensitivity, resolution, linearity, zero drift and full-scale drift, range, repeatability and reproducibility.

Sensitivity is a measure of the change in output of the sensor relative to a unit change in the input (the measured quantity.) Example: The speakers you purchase for your home entertainment may have a rated sensitivity of 89 dB Signal Pressure Level per Watt per meter.

Resolution is the smallest amount of change in the input that can be detected and accurately indicated by the sensor.

Linearity is determined by the calibration curve. The static calibration curve plots the output amplitude versus the input amplitude under static conditions. Its degree of resemblance to a straight line describes the linearity.

Drift is the deviation from a specific reading of the sensor when the sensor is kept at that value for a prolonged period of time. The *zero drift* refers to the change in sensor output if the input is kept steady at a level that (initially) yields a zero reading. Similarly, the *full -scale drift* is the drift if the input is maintained at a value which originally yields a full scale deflection. Reasons for drift may be extraneous, such as changes in ambient pressure, humidity, temperature etc., or due to changes in the constituents of the sensor itself, such as aging, wear etc.

The ***range*** of a sensor is determined by the allowed lower and upper limits of its input or output. Usually the range is determined by the accuracy required.

Repeatability is defined as the deviation between measurements in a sequence when the object under test is the same and approaches its value from the same direction each time. The measurements have to be made under a short enough time duration so as not to allow significant long term drift. Repeatability is usually specified as a percentage of the sensor range.

Reproducibility is the same as repeatability, except it also incorporates long time lapses between subsequent measurements. The sensor has to be operation between measurements, but must be calibrated. Reproducibility is specified as a percentage of the sensor range per unit of time.

Dynamic Characteristics

The **dynamic characteristics** of a sensor represent the time response of the sensor system. Knowledge of these is essential to fruitfully use a sensor. Important common dynamic responses of sensors include rise time, delay time, peak time, settling time percentage error and steady-state error.

Rise time is the time it takes a sensor to pass between 10% to 90% of the steady state response.

Delay time is the time it takes to reach 50% of the steady state value for the first time.

Peak time is the time it takes to reach the maximum reading for the first time for a given excitement.

Settling time is the time it takes the sensor to settle down to within a certain percentage of the steady state value (say ±1%).

The ***percentage overshoot*** is a measure of the peak minus the steady state value, expressed as a percentage of the ssv.

Steady-state error is the deviation of the actual steady-state value from the desired value. It can be corrected by calibration.