

SENSORS AND ACTUATORS

Transducers can be categorized by which direction information passes through them:

- A *sensor* is a transducer that receives and responds to a signal or stimulus from a physical system. It produces a signal, which represents information about the system, which is used by some type of telemetry, information or control system.
- An *actuator* is a device that is responsible for moving or controlling a mechanism or system. It is controlled by a signal from a control system or manual control. It is operated by a source of energy, which can be mechanical force, electrical current, hydraulic fluid pressure, or pneumatic pressure, and converts that energy into motion. An actuator is the mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.
- Bidirectional transducers convert physical phenomena to electrical signals and also convert electrical signals into physical phenomena. An example of an inherently bidirectional transducer is an antenna, which can convert radio waves (electromagnetic waves) into an electrical signal to be processed by a radio receiver, or translate an electrical signal from a transmitter into radio waves. Another example is voice coils, which are used in loudspeakers to translate an electrical audio signal into sound and in dynamic microphones to translate sound waves into an audio signal.

Passive vs active sensors

- *Passive* sensors require an external power source to operate, which is called an excitation signal. The signal is modulated by the sensor

to produce an output signal. For example, a thermistor does not generate any electrical signal, but by passing an electric current through it, its resistance can be measured by detecting variations in the current or voltage across the thermistor.

- *Active* sensors, in contrast, generate an electric current in response to an external stimulus which serves as the output signal without the need of an additional energy source. Such examples are a photo diode, and a piezoelectric sensor, thermocouple.