Active and Passive Sensors

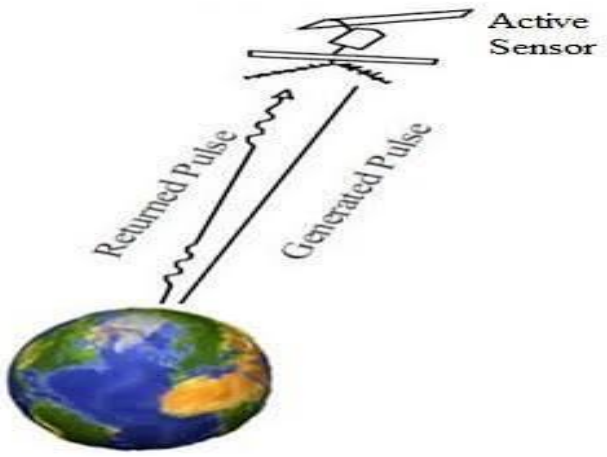
Active sensors generate their own energy source to illuminate targets (like radar/LiDAR) and measure the reflection, allowing 24/7 operation but requiring power; passive sensors detect naturally occurring energy (like sunlight or heat), are simpler, require no external power for sensing, but depend on ambient conditions (daylight/emissions). The key difference is power: Active sensors emit energy, while passive sensors receive existing energy, making active sensors more complex but controllable, and passive ones simpler but dependent on natural light or heat.

Active Sensors

Principle: Emit their own energy (e.g., microwave, sound, light) and measure the backscatter or reflection from the target.

Power: Require an external power source to generate signals, making them “energy-dependent”.

Examples: Radar, LiDAR (Light Detection and Ranging), SONAR, laser



rangefinders, ultrasonic sensors.

Advantages:

Can operate day or night, in any weather condition.

Provide control over emitted signal, offering consistent data.

High sensitivity and signal strength.

Disadvantages:

More complex and expensive.

Higher power consumption.

May influence the target due to emitted energy.

Passive Sensors

Principle: Detect naturally available energy, such as sunlight, thermal radiation (heat), or sound waves.

Power: Do not need external power to generate a signal; they just detect existing energy, making them “energy-independent” for sensing.

Examples: Optical cameras (using sunlight), infrared (thermal) sensors, microphones, passive infrared (PIR) motion detectors, RTDs, Strain Gauges (require excitation circuit).

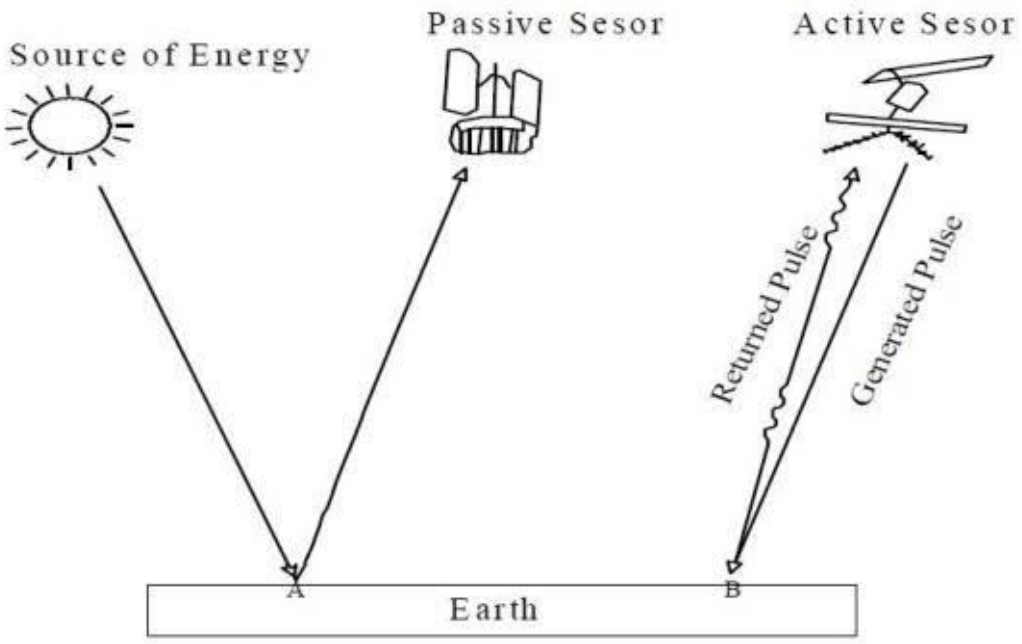


Fig 2.2 active and passive sensor

Advantages:

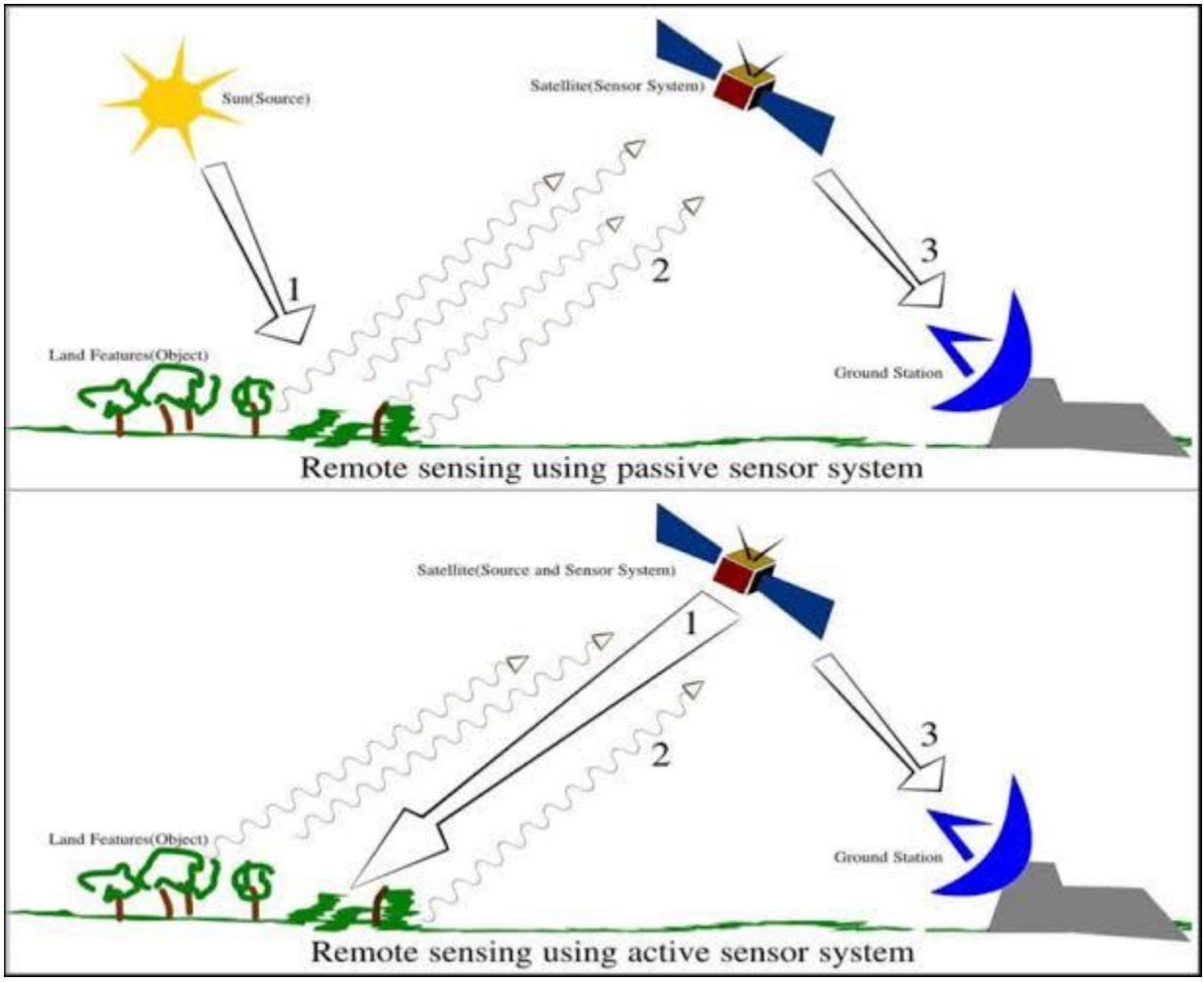
Simpler, lower cost, less power (for sensing).

Less intrusive; measure ambient conditions.

Disadvantages:

Dependent on natural energy sources (e.g., only work in daylight for visible light).

Lower signal strength, more susceptible to environmental interference.


Sun(Source)
Satellite(Sensor System)
1
2
3
Land Features(Object)
Ground Station
Remote sensing using passive sensor system
Satellite(Source and Sensor System)
1
2
3
Land Features(Object)
Ground Station
Remote sensing using active sensor system