

Analysis of the Johnson Criteria for Vision and Surveillance Systems

The Johnson Criteria, developed in the 1950s by Dr. John Johnson, serves as a fundamental standard for evaluating the detection and recognition capabilities of objects in electro-optical imaging systems. This empirical model was designed to estimate the minimum resolution required for a system to successfully perform specific operational tasks, such as detecting and identifying a target, based on the number of pixels representing the critical dimensions of the object. Even today, this criterion underpins the design of CCTV systems, with or without AI, using both IP technologies with daylight-sensitive sensors and thermal sensors.

Minimum Resolution Requirements in Pixels

The criterion is based on representing the critical dimension of the object (e.g., a person's height or a vehicle's width) using a minimum number of pixels to meet various objectives:

1. **Detection:**

- **Requirement:** The object must be represented by at least 2 pixels along its critical dimension.
- **Objective:** To determine the presence of an object in the scene.

2. **Orientation:**

- **Requirement:** At least 3 pixels are needed along the critical dimension.
- **Objective:** To establish the orientation of the object, such as whether it is vertical or horizontal.

3. **Recognition:**

- **Requirement:** The object must be represented by 8 pixels along its critical dimension.
- **Objective:** To identify the general type of object, such as distinguishing a person from a vehicle.

4. **Identification:**

- **Requirement:** At least 13 pixels are needed along the critical dimension.
- **Objective:** To recognize the object in detail, such as identifying a specific person or a vehicle model.

Practical Applications

The Johnson Criteria is primarily used to design and evaluate surveillance and machine vision systems. For example:

- **Camera Design:** Defines the resolution.

Minimum Resolution: Specifies the minimum resolution required to ensure that a camera meets specific operational needs, such as monitoring sensitive areas or controlling traffic.

- **Calculation of Operational Distances:** It is used to estimate Maximum Distances: To calculate the maximum distances at which a camera can detect, recognize, or identify an object.

Operational Considerations:

While providing a 50% probability of success for the defined task, the Johnson Criteria should be regarded as a starting point for designing vision systems. In critical situations, such as the surveillance of strategic infrastructure or forensic identification, it is advisable to adopt safety margins and consider environmental factors such as:

- **Quality of optics and sensor.**
- **Atmospheric Conditions** (es. Fog, rain, low light.).
- **Visual Contrast** Between the object and the background.

Conclusions

The Johnson Criteria provides a standardized approach for designing and evaluating advanced surveillance and imaging systems. Its application allows for the optimization of camera and sensor selection to ensure reliable results across a wide range of operational scenarios.