Designing a Site with Avigilon Video Analytics

Avigilon HD cameras and appliances with video analytics are easy to install and can achieve positive analytics results without ongoing software adjustments. Avigilon's patented video analytics automatically adjust to the camera's field of view (FoV) requiring no configuration or adjustment.

There are two modes of video analytics:

- **Classified Object** mode detects and classifies objects such as a person or a vehicle. You can set up rules and alarms based on this detection. You can also use the Avigilon Control Center (ACC) software Classified Object search to find all instances of a person or vehicle in recorded video using this video analytics mode.
- **Unusual Motion** mode detects motion and compares the speed, direction, and location of movement with what is typical for a scene. It displays anomalies so you can review recorded video that might not otherwise be seen.

  NOTE: Unusual Motion mode is a recorded video feature only available on ACC™ software version 6.8. It is not available on the Avigilon Blue™ cloud platform.

For video analytics to perform effectively, the analytics cameras (or cameras connected to an ACC ES Analytics Appliance) must be installed correctly. Not all devices support each analytics mode. For more information, see your device's datasheet.

Video analytics enabled cameras must be:

- Within the height and angle guidelines.
- Installed where there is sufficient light in the area of interest.
- Within sight of the area of interest for the video analytics to best identify objects or unusual motion.
- Monitoring a scene with sufficient contrast to detect foreground motion.
  For example, a person walking in white clothes in a snow-covered FoV may provide poor results.

The installation guidelines for Classified Object mode are more strict than the guidelines for Unusual Motion mode. If you think that you may want to switch between these two modes, follow the Classified Object guidelines. Cameras installed according to the guidelines for Classified Object mode will also work for Unusual Motion mode.

The following information provides a basic set of installation parameters. Read through the entire document before installing cameras.

For site requirements that deviate from the listed recommendations, or when in doubt, consult with an Avigilon representative before installing the cameras.

Designing for Classified Object Detection

Design your site with the following guidelines to use video analytics in Classified Object mode.
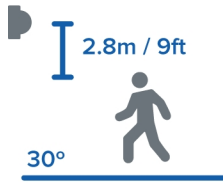
General Guidelines

In general, cameras should be installed according to the following guidelines to achieve optimal analytics performance:
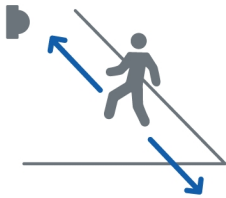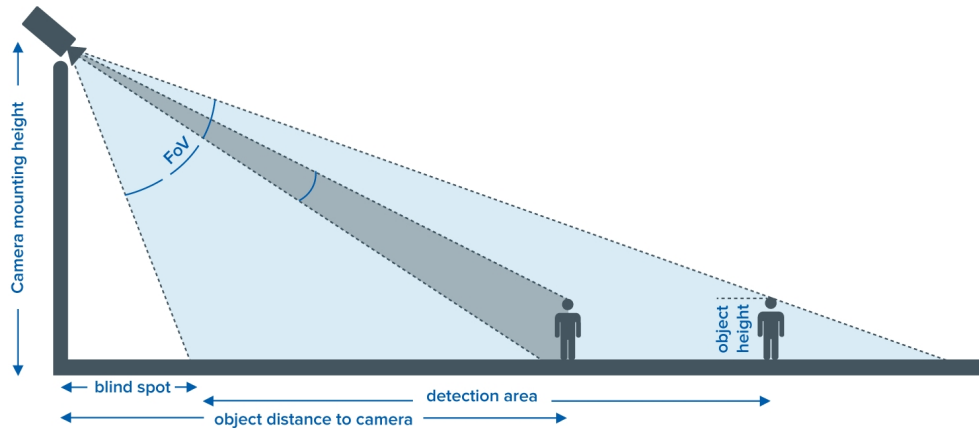
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- Cameras must be able to see moving objects in the field of view (FoV) for a minimum of 2 seconds.
- 5 seconds is recommended for optimal object classification.

2.8m / 9ft

30°

- Cameras should be mounted at a minimum of 2.8 meters (9 feet) level to the horizon and ground plane (for outdoor or large indoor areas).
- Cameras can be tilted within 30° from the horizontal for optimal object classification.
  - Increasing the tilt angle can help in detecting targets that are directly approaching the camera.
  - The camera should be tilted no more than 45° from the horizontal.
- Cameras should be mounted to a stable surface to minimize vibration and movement.

- Select a lens, mounting height and tilt angle to capture the required level of detail for Classified Object detection within the scene.

- Camera FoV must be level with the horizon.
- People in the FoV should be walking upright.
- People and cars moving parallel to the FoV provide better results than objects moving to or from the camera.

For more details related to your particular type of camera or scene, see the related section below.

For more details related to the Avigilon Appearance Search™ feature, see *Avigilon Appearance Search Feature* on page 10.

NOTE: Analytics on wide-angle or fisheye/panoramic lenses are not supported at this time.
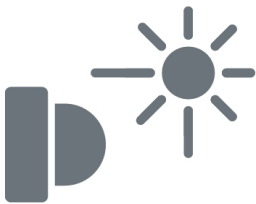
Analytics Location Mode

In the ACC Client software, set the camera's Analytic Events to use the Location mode that best describes the scene:

- **Outdoor** — this option is suitable for most outdoor environments. This setting optimizes the camera to identify vehicles and people.
- **Outdoor High Sensitivity** — only use this option if you require the system to be more sensitive than the Outdoor setting. This option is optimized to run with higher sensitivity for detecting people and vehicles in challenging outdoor scenes. Be aware that this option will generate more false positives.
- **Large Indoor Area** — this option only detects people and is optimized to detect people around obstructions, like chairs and desks, if the head and torso are visible.
- **Indoor Overhead** — this option is optimized for cameras mounted directly overhead and should only be used when a torso cannot be seen in the camera FoV. Any movement is assumed to be human. It can be used in areas with limited space but with high ceilings, or to monitor doors. It should not be used with the Avigilon Appearance Search feature, or to detect people traveling against the crowd.

Reflected Light

- Avoid direct light sources.
  - The camera may be temporarily blinded if bright light sources shine directly at the camera.
- Position the camera so that the sun, headlights, or other light sources do not shine directly into the lens.
- Avoid installing the camera in areas with drastic changes in lighting throughout the day. For example an indoor space with direct sunlight through a skylight or large windows.
  - Significant changes in lighting cause large shadows and different coloring in the space. Such changes may generate inconsistent detection results.
- Be conscious of indirect light sources, including reflections from built-in or external IR illuminators, to avoid lens flares and loss of contrast in the image.
  - Cameras with wide dynamic range (WDR) may be able to overcome this issue in some instances.
- Avoid mirrors and other reflective surfaces (like shiny floors and ceilings). Reflections may cause additional false detections.

Headlights

Headlights can pose a challenge to video analytics, combining low-light conditions with extreme differences in lighting.

Headlights can interfere with video analytics when:

- The light shines directly into the camera.
- The scene is too dark.
- The light reflects on wet, snowy, or icy roads.
  - This happens mainly at night, but can also occur during the day when headlights are reflected into the camera from wet pavement.
- The light is reflected back at the camera from an enclosed environment, such as a tunnel.

Camera positioning and testing prior to installation are important to minimize reflected light.

- Position the camera so objects are viewed from the side and not from the front.
- Use thermal cameras instead of visible cameras. Thermal cameras will ignore stray headlights and reflected light.
- Add additional illumination (IR or white light) to help balance extreme lighting contrasts.

Contact your Avigilon representative for advice on installing cameras when headlights are present in the FoV.
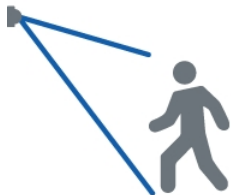
Adaptive IR

Adaptive IR functions by adjusting the IR output dynamically to prevent oversaturation in the scene as the light changes throughout the night.

- Cameras using only built-in IR for illumination at night detect targets at a much shorter distance. Additional illumination is required to consistently detect targets.
- Be aware that IR may also blur the outline of objects and negatively impact the accuracy of the video analytics.
  - You can disable adaptive IR to help improve Classified Object detection in the scene.

Lux on Target

- The recommended minimum illumination is 8 lux on target for analytic cameras.
- For non-analytic, third-party cameras that are connected to the ACC ES Analytics Appliance, the minimum illumination requirement varies from camera to camera.
  - More light is required if the third-party camera does not have an IR cut filter or a monochromatic night mode.
- For illuminating distances, it is important to account for lighting, weather, contrast and camera stability conditions.
  - In bad weather with low visibility, analytics should be combined with other detection methods to ensure a secure system.

Contact your Avigilon representative for advice on installing in challenging lighting situations.

Obstructions

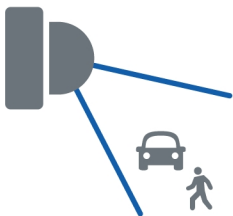To identify objects accurately, the scene must be clear.

- For outdoor applications, avoid placing a camera where the FoV includes foliage, terrain or large objects that occlude the subjects of interest.
  - Also pay attention to obstructions that can reflect IR illumination back to the camera and cause reduced contrast or overexpose camera video at night. This can be corrected by adjusting any of the following:
    - Separate the IR illuminators.
    - Adjust the camera placement.
    - Correct the aim of the IR illuminators or the camera.
- For indoor applications, a person may be detected as long as their upper body, including head and shoulders, is visible.
  - It is recommended that a person be fully visible for the Avigilon Appearance Search feature to provide better matching search results.

  For more information, see *Analytics Location Mode* on page 3.
- Avoid using analytics in crowded areas where people are likely to overlap and block each other from the FoV.

  Overlapping objects in the scene may cause the system to miss potential results.

Coverage Area

- Performance is best in open, uncrowded environments where people are not overlapping or obstructed in the FoV.
- Install the camera in a location where each object appears in the FoV for at least 2 seconds.
  - If an analytic rule or alarm uses a region of interest (ROI) or beam crossing to trigger an event, make sure objects are detected in the camera FoV for at least 2 seconds before entering the ROI or crossing a beam.

- For advanced users, use the following pixel on target recommendations:
    - 24 to 36 pixels per meter (8 to 11 pixels per foot) based on 2.0 MP resolution.
    - Maximum target size = 2/3 height of the FoV.
    - For the Avigilon Appearance Search feature:
        - 72 pixels per meter (22 pixels per foot) based on 2.0 MP resolution.

Use the Avigilon System Design Tool to help you estimate the required coverage area. The System Design Tool is designed to incorporate Avigilon analytic needs and determines the camera's maximum video analytics detection area in a given scene. To access the System Design Tool, go to **https://sdt.avigilon.com**.

Outdoor Areas

Be careful not to select a coverage area that is too large, objects may become obscured by rain or fog *even* when there is enough lighting and contrast.

Indoor Areas

Make sure the indoor coverage area is not too small. Low ceilings or confined spaces (such as a man-trap area between secured doors) may pose problems with establishing a scene that fits the recommended criteria.

- FoV should be at least 9 m (30 ft) wide, even if the region of interest is much smaller.

Object Velocity

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Beyond the velocity recommendations referenced in the **General Guidelines**, be aware of the following details:

- Objects that enter the FoV from behind the camera may take up to 4 seconds to be classified.
- If fast, lateral-moving vehicles are expected, use a wider field of view to increase the available observation time.

Outdoor Camera Placement

- Make sure the camera FoV overlaps to ensure adequate coverage in the blind spot immediately below a camera.
- Mount cameras on a central building or structure looking out towards the perimeter.
- Exceptions:
  - Mount cameras on the perimeter if covering exceptionally large areas.
  - Do not mount on the central building if there is no suitable mounting location, or if there are obstructions in important areas of the FoV.

Self-Learning

Avigilon cameras include state-of-the-art object detection and classification. These cameras also employ additional algorithms including Self-Learning and Teach by Example to reduce false detection and alarm rates.

- Self-Learning is enabled by default in the ACC system.
- Self-Learning improves analytics decision making power over time by learning the physical relationship of objects moving across the FoV.
- The camera or video analytics appliance automatically applies the mathematics of perspective to adjust itself and reduce the number of false alarms.
- Self-Learning is activity-based to allow cameras or appliances to actively learn only when there is movement in the scene. Learning does not progress when the scene is empty or when it has low illumination.
- Generally requires approximately 200 high-confidence detections throughout the entire FoV for good adjustment.
- The time needed to complete Self-Learning (100%) varies from scene to scene, depending on activity.
- Self-Learning recommendations:
    - For most situations, only Self-Learning is required for the camera to learn the scene.
    - Ideal for scenes where objects are on the same plane.
- You may want to disable Self-Learning for the following scenes:
    - Scenes where objects move at different height levels.
    - Scenes where objects can be observed at different levels that appear relatively close in the FoV. For example, overhead pedestrian bridges, train platforms, hills and underpasses.
    - To disable Self-Learning, see the *Avigilon Control Center Client User Guide*.
- Teach by Example:

  Teach by Example is a feature that allows users to provide feedback by validating the accuracy of classifications done by the system.

    - Teach by Example is recommended if the system reports an undesirable number of false alarms after Self-Learning is complete, or has been disabled based on the preceding recommendations.
    - Teach by Example is not required, but can be used to help refine classification of people and vehicles to further reduce the number of false alarms.
    - You can perform Teach by Example after Self-Learning is complete, or when Self-Learning is disabled.
    - If you decide to disable Self-Learning after having executed a Teach by Example exercise, you may need to teach the system again to account for classified results that were previously filtered by Self-Learning.

It is strongly recommended that you reset the Self-Learning setting once the camera is stable after initial configuration. During installation, a camera is frequently adjusted, so any Self-Learning the system was able to do would become invalid.

NOTE: Always reset Self-Learning and Teach by Example after a camera is physically moved or adjusted, and if the focus or zoom level is changed. The change in the camera's FoV affects the video analytic results.

In the case of only lighting changes or IR installation, it is not necessary to reset Teach By Example. However, adding more examples of true and false classifications with the new lighting will be beneficial. On the other hand, Self-Learning should be reset when making lighting changes.

You can reset Self-Learning and Teach by Example from the ACC Client software. For more information, see the *Avigilon Control Center Client User Guide*.

Avigilon Appearance Search Feature

Security investigators or operators can use the Avigilon Appearance Search feature with ACC software to find all instances of a person or vehicle in recorded video quickly and easily. ACC software stores information about each detected person or vehicle and uses these attributes when performing the search.

Beginning with the ACC 6.6 software release, the Avigilon Appearance Search feature uses a good quality face image of a person, if available, as additional information for reinforcing search accuracy and reliability. If a good face image was captured of the person of interest, then it's automatically included as a search parameter. The search cannot be performed on a face alone.

A face image provides unique and consistent characteristic information to help search for people across a site even if their clothing has changed over time or if they are dressed like others in the same area.

NOTE: ACC ES Analytics Appliances, ACC ES Analytics Cameras, and thermal cameras do not currently support the Avigilon Appearance Search feature.

- The system must be running ACC 6 Enterprise software.
- The network video recorder (NVR) must have the Analytics Kit installed.
- Ensure the camera supports Avigilon Appearance Search feature.
    - In the ACC Client software, open the camera's Setup > Analytic Events dialog box and select the **Enable Appearance Search** check box.
    - The feature must be enabled for each individual camera in the system.
    - For full-body images, the camera must have the following number of pixels on target for optimal performance.
        - 72 pixels per meter (22 pixels per foot) based on 2.0 MP resolution.

- To include face images to enhance a search, the camera must be positioned to collect predominantly front facing images that use the following pixels on target:
    - Minimum — 236 pixels per meter (72 pixels per foot) based on 2.0 MP resolution. This translates to approximately 40 pixels on the width of a face.
    - Recommended — 394 pixels per meter (120 pixels per foot) based on 2.0 MP resolution. This translates to approximately 65 pixels on the width of a face.
    - If the camera is not positioned to capture good face images, the search is performed on the full-body profile images alone.
- Avoid mirrors and other reflective surfaces (like shiny floors and ceilings). Reflections may cause additional false detections.
- It is recommended that the Avigilon Appearance Search feature only be enabled on cameras using Outdoor or Large Indoor Area location mode.
    - The other location mode options may generate extraneous results. Disable the Avigilon Appearance Search feature for cameras using the other location modes.
    - For more information about the different location mode options, see *Analytics Location Mode* on page 3.

For more information about the ACC 6 and Avigilon Appearance Search system requirements, see the ACC 6 software datasheet or the *Avigilon Control Center 6 Client User Guide*.

Camera Placement For Avigilon Appearance Search Technology

- Focus the FoV of the camera to important junction points. This is especially important when using Avigilon Appearance Search technology because it helps investigators understand where people travel over time.
    - Entrances and exits
    - Hallway junction points
- To help enhance Avigilon Appearance Search results, position some cameras close to eye level to detect front-profile face images for face analytics.
    - For optimal results, tilt the camera 10-15 degrees from the horizontal.
    - The camera should *not* be tiled more than 25 degrees from the horizontal.
- Avoid busy environments where images of people often overlap.
    - It is difficult for the camera to clearly distinguish different objects in the scene if it is too busy.
    - For busy environments, use several cameras to focus on each junction/exit so that you can use the Avigilon Appearance Search feature to plot the general movement of people of interest. Use non-analytics cameras for situational awareness.

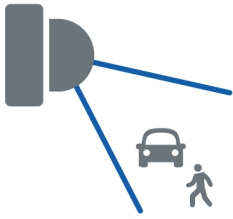# Designing for Unusual Motion Detection

The Unusual Motion algorithm continuously learns and adapts to the camera's FoV and flags unusual motion in recorded video.

Design your site with the following guidelines to use video analytics in Unusual Motion mode.

NOTE: ACC ES Analytics Appliances, ACC ES Analytics Cameras, and thermal cameras do not currently support the Avigilon Unusual Motion detection feature.

NOTE: If you plan to switch between video analytics modes, follow the installation guidelines for Classified Object mode.

Coverage Area

- Select a mounting height and tilt angle to capture the desired level of detail for the motion in the scene. The camera does not need to be level with the horizon.
    - Position the camera so that it can observe the speed and direction of motion in the scene.
        - To detect unusual motion from fast-moving objects such as vehicles, use a wider field of view to ensure the object is in the camera's FoV for at least a few seconds.

            For example, a downward-facing camera installed at 7 feet may not detect unusual motion from a fast-moving bicycle because the bicycle was only in the FoV for a second.
    - Position the camera so that the height of the objects in the FoV are generally less than 20% of the height of the FoV.
        - Rare and infrequent motion that is up to 66% of the FoV can be tolerated, but very large frequent objects may cause undesired motion learning.
- For advanced users, use the following pixel on target recommendations:
    - 16 to 32 pixels per meter (5 to 10 pixels per foot) based on 2.0 MP resolution.
    - Maximum target size = 2/3 height of the FoV.

Lighting

Fast lighting changes can generate Unusual Motion events.

- Constant, consistent lighting will result in better results.
- Avoid headlights and reflections.

Expected Results

Unusual Motion mode only detects motion in the FoV, not objects.

- Although a vehicle driving on a busy sidewalk is unusual, an event may not be triggered because motion in the FoV is typically seen on the sidewalk.
- Infrequent, tall vehicles like trucks or buses may trigger an event because motion is typical in the FoV where cars appear, but not where taller vehicles appear.

For More Information

If after reading this document you discover that your site requirements deviate from the recommendations, consult an Avigilon representative before installing the cameras. We cannot help you troubleshoot potential issues with Classified Object or Unusual Motion detection if you do not follow our recommendations or seek assistance before installing cameras.

To contact an Avigilon representative in your area, see: **avigilon.com/contact-us**

For more information about configuring Self-Learning, Teach by Example and other video analytics features that are available in the ACC software, see *Avigilon Control Center Client User Guide*.