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FIELD EVALUATION OF NEW EXTERIOR VIDEO MOTION DETECTION SYSTEMS

SAND--89-1616C

DE89 014515

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ABSTRACT

Considerable interest has been generated within the past several years concerning the use of new generation video motion detection (VMD) systems as exterior intrusion sensors. The new generation VMD systems advertise advanced video signal processing techniques and algorithms which are aimed at rejecting nuisance alarm sources inherent to the uncontrolled exterior environment. Older generation VMD systems used in an exterior environment tend to have high nuisance alarm rates. The high nuisance alarm rates of the older systems made them generally unacceptable for use as an exterior sensor. This paper discusses the results of continued field testing of new generation VMD systems. Field tests were conducted in an exterior perimeter zone application and an application looking at the exterior entrance of a building. Test results include each VMD system's detection capabilities and nuisance alarm characteristics for each particular application. Also site considerations such as lighting, cameras and zone layouts for exterior video motion detection are discussed.

INTRODUCTION

Video Motion Detection can be attractive in a number of ways for exterior intrusion detection or as a video assessment aid. Low installation cost is a primary advantage if CCTV camera assessment is existing or planned. There is no equipment or cables to install in the field. The absence of equipment in the field (other than CCTV cameras) allows a VMD detection area to be covert. VMD systems can aid in CCTV assessment because most VMDs highlight the area where an alarm is occurring.

An increasing number of VMD systems are appearing on the commercial market which advertise for exterior use. All of the new VMD systems employ digital processing techniques for change detection and nuisance alarm reduction. The amount of digital processing varies widely between the available systems. This report discusses an on-going evaluation of exterior VMD systems. The systems being evaluated are:

1. DAVID (Digital Automatic Video Intrusion Detection)
   Computing Devices Company Canada:

   a. Model DC 100N--Standard Bi-directional
   b. Omnidirectional (OMD)--prototype DAVID version for detection in all directions

2. Teletect VS-30
   Geutebruck Videotechnik GmbH, West Germany

3. VSM-210
   Sas-Tec GmbH, West Germany

4. Wisco Teleguard AS-16
   Wood-Ivey Systems Corp, Winter Park, FL

SYSTEM DESCRIPTIONS

General. Although these new digital VMD systems vary in motion detection capabilities and techniques, there are basic similarities in their operation. In all the systems tested, an area within a video scene is programmed by the user for motion detection. This detection area is comprised of, or divided into, smaller areas (termed cells, zones, boxes, or dots). These smaller areas are monitored on an individual basis for level changes using digitized video signal information. A change detected in any one small area does not generate an alarm; additional processing for nuisance alarm reduction is performed.

The amount and techniques of additional VMD processing is where systems vary the most. The main features resulting from additional processing seen among the various systems are:

Tracking--looking for logical movement through a certain distance.

Size Filtering--ignoring objects which are too small

Velocity Filtering--alarming only on objects moving within a certain velocity range.

Global Filtering--ignoring overall scene changes.

At least one of these features was seen in each of the systems tested. Some of the systems had a number of these plus additional features.

The video motion systems tested include operator adjustable parameters for optimizing performance. These include detection threshold adjustments and nuisance alarm rejection adjustments. Programmable detection thresholds adjust the amount of level change necessary in order for the system to see a change. Most VMD manufacturers suggest initial settings of parameters and recommended further testing in a particular application for optimizing detection capability and nuisance rejection.

DAVID Bi-directional and OMD. Both DAVID versions divide a detection area into smaller areas called "cells". DAVID includes logical tracking of targets through individual cells, size and velocity filtering, and global filtering. The size of the cells are programmable and are usually set for optimum detection of human-size targets. Other features of DAVID include perspective compensation and automatic thresholding. Perspective compensation allows for uniform detection sensitivity while objects change apparent size with distance from a camera. Thresholds are automatically changed by DAVID during rapidly changing background conditions.

The standard bi-directional DAVID allows for the operator to program two detection threshold levels, and a tracking threshold. Detection threshold I is in effect when overall video scene conditions are constant. The system detects when large scale changes are occurring (ie; cloud shadow movement, camera motion) and switches to a less sensitive threshold II. The tracking threshold allows the user to program the number of cells which a target must be logically tracked before an alarm is declared.

The bi-directional DAVID tracks movement on a horizontal basis only. Targets moving strictly towards or away from the camera, without any movement across the scene are not alarms. With only horizontal detection, a primary application for the bi-directional DAVID is detection of human size targets crossing a secure perimeter-type area.

Previous tests on the bi-directional DAVID have been conducted by Sandia National Laboratories.[1] The previous tests showed that a major contributor to nuisance alarms was slow moving object shadows at dusk and dawn. Since those tests, new firmware was introduced which allows for a larger detection area and an additional parameter for reducing dusk and dawn object shadow alarms. The tests on bi-directional DAVID discussed in this paper are with the new firmware.

The OMD DAVID tested is a prototype system, not yet commercially available. This is an enhanced version of the standard DAVID which detects targets moving in both vertical and horizontal directions. Detection in both directions allows DAVID to be used in other applications such as a wall-type area where detection in all directions is desired.

The OMD prototype has three detection thresholds and two tracking thresholds. Thresholds I and II operate the same as in the Standard DAVID. Threshold III, which is set at slightly less sensitivity than threshold II, is switched into effect during long term cloud activity. There are additional parameters which allow definition, in terms of time, for long term cloud activity.

There are two tracking algorithms, horizontal and vertical. Adjustable thresholds for each allows the user to define the number of cells in the horizontal and vertical direction that a target must be tracked before an alarm is declared. The OMD can be programmed with both tracking algorithms on, with only vertical on, or only horizontal on. With only horizontal tracking, the OMD operates similar to the standard DAVID.

There are a number other parameters and enhancements provided in the OMD version which are not in the standard DAVID. These include operator adjustment for number of cells within the detection area for determination of cloud activity or global change.

Geutebruck VS-30. The detection area in this system is comprised of "zones". There are 20 zones per VMD channel. Each zone can be programmed with respect to size, position in the scene, and function. When a zone size is defined, the sensitivity of that zone is automatically adjusted in accordance with its area. Perspective compensation for uniform sensitivity can be established by sizing zones accordingly throughout a scene. Per manufacturer's recommendations, zones should be sized to match the object being detected. A zone can be defined as a pre-alarm zone, a main alarm zone, or a suppression zone. By using pre-alarm and main alarm zones, a tracking criteria can be established.

When contrast changes occur within a small number of zones, a positive motion value results. The motion threshold parameter determines the minimum motion value in order for a zone to declare a change.

Global filtering in this system is termed "suppression". The system detects when contrast variations occur simultaneously in a high number of, or all of the zones. When this global type change occurs, a subtraction from motion values result. The suppression parameter allows adjustment of how much the motion values can be reduced by global changes.

Zones can be programmed to be suppression zones rather than detection zones. Contrast changes in individual suppression zones subtract from motion values. The amount of subtraction due to a suppression zone is effected by the suppression parameter and individual adjustment of each zone. Suppression zones can aid in reducing alarms from slow moving cloud shadows which may not cause changes in a high number of zones at once.

The system has 5 measuring cycles termed A, B, C, D and E. Each has different update timing for change detection. Any one of the cycles can generate a change in the zones. Any of the measuring cycles can be programmed on or off for change detection. Cycle A updates fast, resulting in high detection of fast moving targets. Cycle E updates slow and has high detection of slow moving targets. By selecting certain cycles for detection, velocity filtering can be obtained.

Another feature of this system is termed "operating mode". There are four modes of operation per VMD channel. Each mode can be programmed with different detection, suppression and zone parameters. Changing operating modes can be done via an external input.

SAS-TEC VSM-210 A detection area in the Sas-Tec system is comprised of "surveillance areas" (SA). A total of 896 individually programmable surveillance areas exist in each VMD channel. All SA's are the same size through out the scene. A surveillance area sensitivity parameter adjusts the amount of contrast change required for detection.

An object size feature programs a number of Surveillance Areas to which have to detect a contrast change simultaneously before an alarm can occur.

An alarm chain feature allows definition of a number of surveillance areas that a target has to move before an alarm occurs.

Global filtering is performed in this system by use of "reference areas". Reference areas are similar in programming and setup to surveillance areas. Reference areas are placed adjacent to, or around a detection area. If contrast changes are detected in reference areas and surveillance areas at the same time, alarms are not generated.

This system has two operating modes per VMD channel. The modes allow different parameter and detection area setup. Mode of operation is switched via an internal time clock.

Wisco teleguard AS-16. The detection area is comprised of "dots". The dots are programmable with a light pen. The light pen is moved across the TV monitor scene to mask out dots in areas where detection is not desired. Also, blocks of dots can be masked using a set of switches. Four dot densities, 4000, 6000, 8000 and 12000, are selectable.

The hit count feature allows the user to select the number of times that a target has to be confirmed within the detection area before an alarm is generated. Between use of hit counter and selecting certain dot densities, small targets can be filtered out.

There are two detection threshold settings, selectable with a jumper. These two settings are 6.25 and 12.5% contrast change.

A nuisance program feature is available for fast masking of dots which cause repeated nuisance alarms such as a bush waving in the wind.

TEST SETUP

Test Area Tests were conducted at a video/sensor test bed. The test bed area has a number of perimeter-type zones and bunker type storage areas. The perimeter zones have double fencing spaced 50 feet a part.

The CCTV cameras used in all areas were Cohu model 4835 with 2/3 inch format solid state charged coupled (CCD) imaging devices.

Equipment Configuration. For each VMD system, tests were conducted in one perimeter zone area and in the front wall area of one of the bunkers.

Due to different VMD manufacturer's recommendations for maximum detection distance from the camera, two different perimeter zone areas were used during testing.

The maximum recommended distance for the Sas-Tec system is where the camera horizontal field-of-view (FOV) is approximately 50 feet wide. The other VMD systems had no specific requirements for maximum detection distance from the camera. The test distance for these VMDs was at the point where it is considered the maximum distance for CCTV assessment. This distance is where the camera horizontal FOV is 100 feet wide. The manufacturer or representative of DAVID, Geutebruck and Wisco were contacted regarding using these systems at the 100 foot wide FOV distance. Each one indicated that their system should operate satisfactorily in the application.

Perimeter zone 1 was used for Sas-Tec testing. The detection area setup on the Sas-Tec system was 12 feet wide by 120 feet long. The end of the detection area was 210 feet from the camera. A 35 mm auto-iris lens installed on the 2/3 inch format camera provided 50 feet horizontal FOV width at this distance. The camera was mounted on a stable tower, 20 feet high. See Figure 1.

Perimeter zone 2 was used for DAVID bi-directional, omni-directional, Geutebruck and Wisco testing. The detection area for each system was approximately the same, 25 feet wide by 150 feet long. A 25 mm auto-iris lens installed on the 2/3 inch format camera provided a 100 foot horizontal FOV at 300 feet from the camera. The camera was installed at a height of 25 feet.

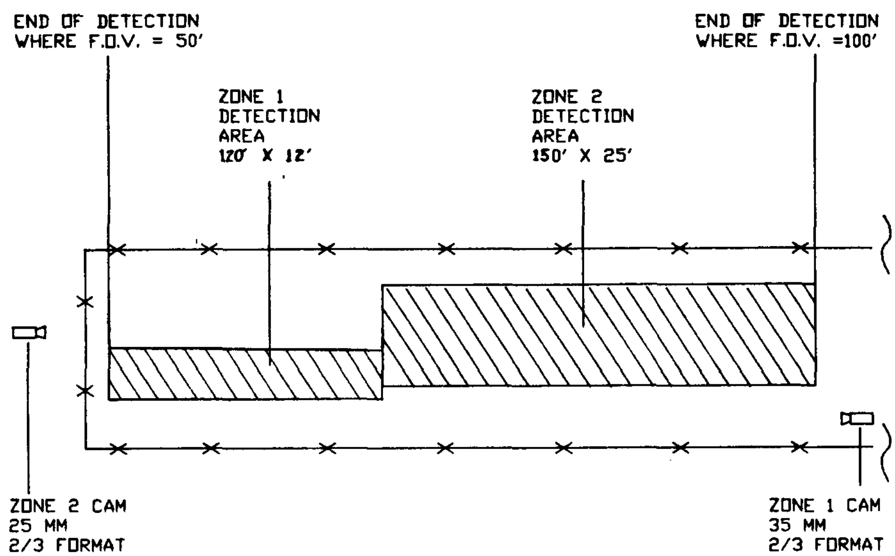


FIGURE 1. Layout of perimeter zones 1 and 2.

The bunker area was used for DAVID omni-directional, Geutebruck, Sas-Tec and Wisco. DAVID bi-directional was not tested in the bunker area. Detection in both horizontal and vertical directions was necessary for this area. The vertical surface wall area, along with an area in front of the bunker, was programmed for detection in each system. Detection of intruders approaching the front door of the bunker was desired. See Figure 2. The camera viewing this area had a 16 mm auto-iris lens and was located 90 feet from the bunker front at a height of 18 feet. The horizontal FOV was 48 feet wide at the wall surface.

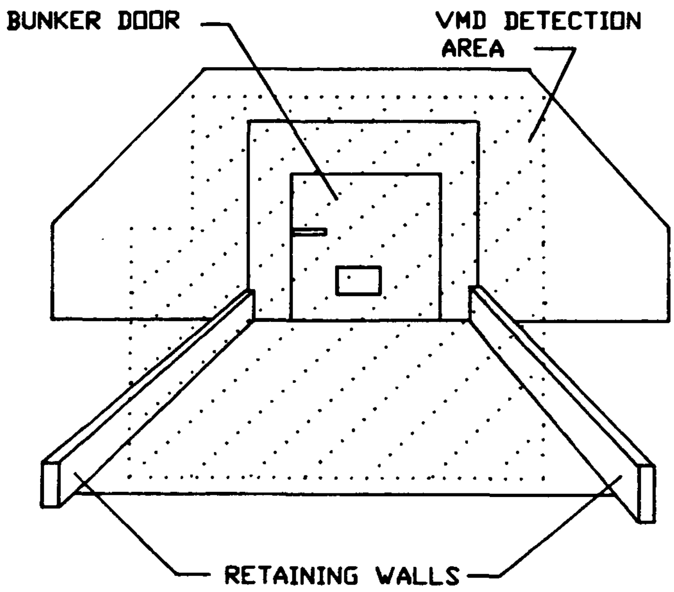


FIGURE 2. Layout of bunker area

The VMD systems, equipment for nuisance alarm data collection and detection testing were located in trailer at the site. Figure 3 is a block diagram of the VMD and data collection equipment.

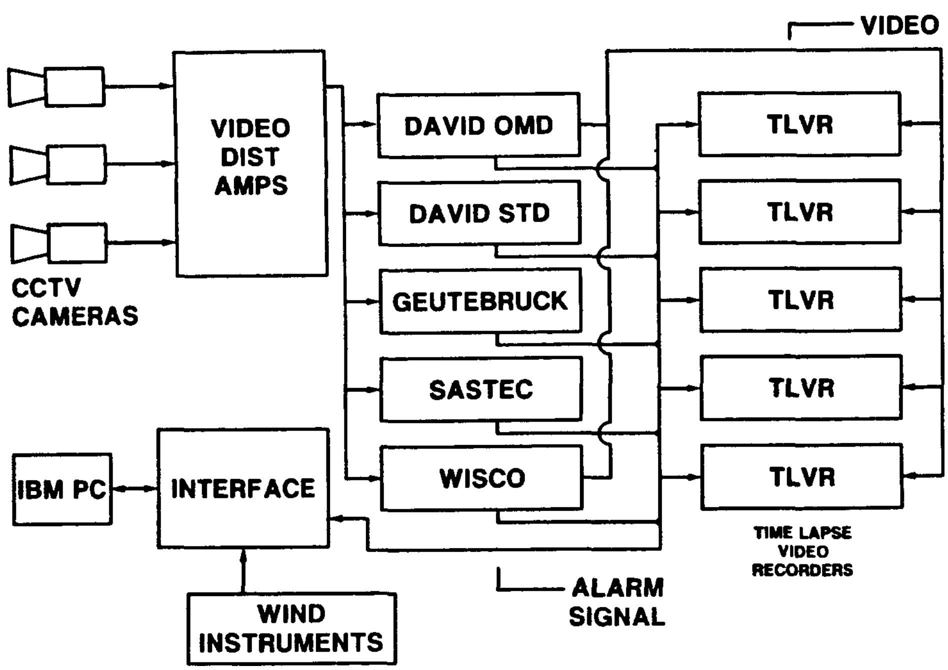


FIGURE 3. Data collection equipment block diagram.

TEST PROCEDURE

Detection capability tests. Detection tests were performed under static background scene conditions and under changing background scene conditions. The goal of the detection tests was to determine optimum parameter settings for high detection capability with lowest possible nuisance alarms. Characteristics of detection capability versus parameter settings were established also.

Under static conditions human intrusion tests through each test area were conducted with various intruder and lighting conditions. The intruder was dressed in camouflage type clothing that best matched the background. Intruder positions included walk, run and side crawl at different distances from the camera. Various lighting conditions included bright sunshine, dusk and night with perimeter lighting.

For changing background conditions, detection tests were conducted during cloud shadow movement through each test area. Intruder dress and positions were the same as in the static tests.

Nuisance alarm data collection. Once the optimum parameters were established for the desired detection level, nuisance alarms were monitored and recorded.

Alarm events were recorded on time lapse video recorders and on a personal computer. Alarm relays from each VMD system controlled the time lapse recorders. When an alarm occurred, the video recorders switched from a time lapse mode to a real-time mode of recording. Each alarm event was also logged into a computer file with time of alarm, date, wind speed and wind direction.

Nuisance data collection was turned off periodically so the video tapes could be viewed for alarm assessment. Causes of alarm were entered, via computer keyboard, into the alarm data file. The data file containing time, date, and alarm assessment was used for establishing nuisance alarm rates (NAR) for each system.

TEST RESULTS

Static background detection tests. During testing with a constant, unchanging video scene, worst case conditions for the video motion detectors were identified. Worst case conditions are defined as conditions which require the highest VMD sensitivity setting for high detection capability. This is considered worst case because nuisance alarm rates tend to increase with increasing sensitivity. High detection capability is defined as detection of 100% of the crossings. The worst case for all VMDs was with the intruder in a low profile position with respect to camera view combined with the lowest contrast with respect to the background.

In the perimeter zones the worst case occurred with the intruder crossing in a side crawl position under dusk lighting conditions. The side crawl position is with the intruder's body parallel to the camera optical axis, with his head towards the camera. Dusk lighting is just after the sun has set below the horizon. There are no high contrast shadows of the intruder, but there is still adequate light for the camera to operate properly. Dusk lighting conditions are similar to total, heavy cloud cover conditions.

In the bunker area, the worst case detection occurred in bright sunshine with the intruder crawling towards the bunker front in the shadow cast by the 2 foot retaining walls. Intruder contrast was lowest in the shadow. See Figure 4.

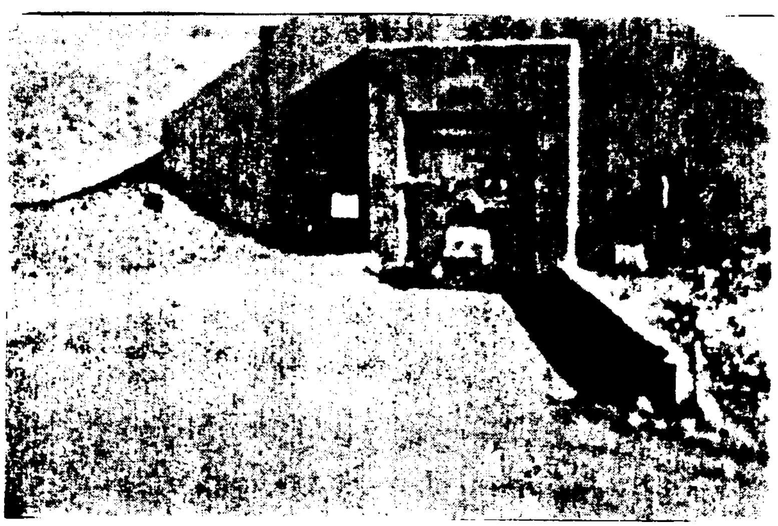


FIGURE 4. Bunker scene

Figure 5 shows a typical graph of detection capability versus detection thresholds. This shape graph occurred during the static background tests. The sensitivity setting at which detection capability began to decrease was different for different intruder and lighting conditions.

Table 1 is a list of sensitivity threshold settings required for high detection capability under worst case conditions. The settings listed for each system are near the knee of the graph in figure 5, just before detection began to decrease. These are the sensitivity settings at which the systems were operated during nuisance alarm data collection.

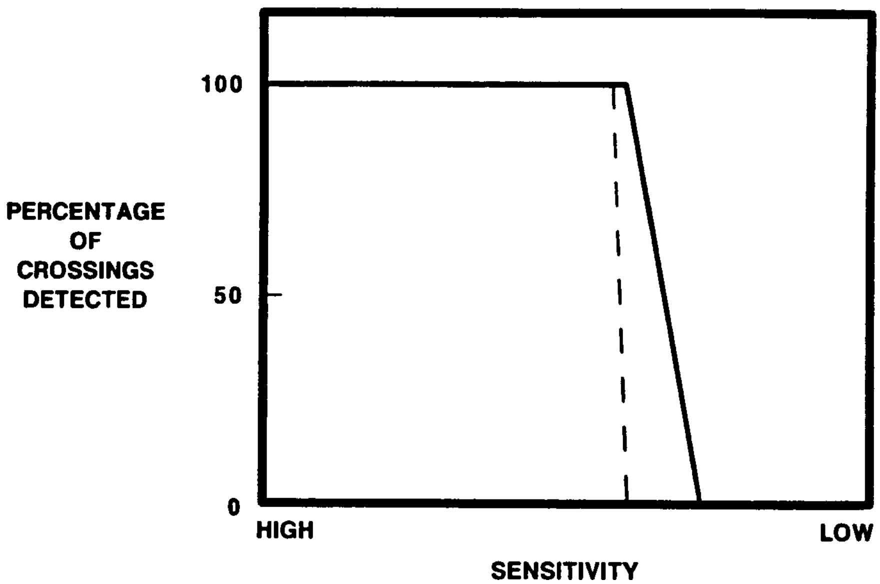


FIGURE 5. Detection vs Sensitivity

VMD (system parameter)	THRESHOLD SETTING Perimeter	Bunker
DAVID OMD (Thres I)	25	25
DAVID STD (Thres I)	25	--
Geutebruck (Motion Thres)	10	10
Sas-Tec (SA sensitivity)	3	3
Wisco (Sensitivity)	6.25	*

* Intruder crawling in shadow cast by retaining wall in bunker scene was not detected with either sensitivity setting.

TABLE 1. Sensitivity settings

Along with sensitivity, other parameters in each system were adjusted during the static scene testing under the worst case conditions. Minimal nuisance alarms were kept in mind when adjusting these other parameters.

DAVID OMD and STD. Horizontal tracking was set to 3, the default setting. Vertical tracking (OMD only) was set to 3 for the perimeter and 2 for the bunker. Threshold II was set to the default setting of 50. Threshold III (OMD) was set to 55, the default setting. The Dawn and Dusk factor sets the minimum horizontal detection velocity. This velocity was set at 1.3 inches per second which was required for no slow moving object shadow alarms. Minimum vertical detection velocity (OMD) was set around 6 inches per second for a low contrast intruder.

GEUTEBRUCK VS-30. Suppression value was initially set to 20. The zones were set in the pre-alarm function, requiring two zones to detect within 7 seconds before an alarm is declared. Measuring cycles B, C and D were turned on, A and E were off. These parameters were used in both the perimeter and the bunker.

SAS-TEC VSM-210. Per the Manufacturers recommendations the Reference Areas were programmed to completely surround the Surveillance Areas. This configuration of the Reference areas provided the best global change rejection. Reference Area sensitivity was initially set to 3, the default setting. The Object Size parameter was set to 3. This was the maximum size setting for detection of the smallest profile intruder, at the furthest distance from the camera. Alarm chain was set to 3.

WISCO AS-16. During the static background tests the combinations of Dot Density and Hit Count were programmed. These two parameters affected detection with respect to intruder size. In the perimeter zone, a hit count of 2 was required for high detection capability of a low contrast, side crawling intruder at the end of the detection area. In the bunker area, a hit count of 8 with a dot density of 4000 provided high detection in all tests, except the crawl through the retaining wall shadow. Even at the maximum dot density of 12,000 and a minimum hit count of 2, there was no detection in the shadow.

Changing background detection tests. In four of the systems tested, global scene changes invoke temporary changes to operating parameters. The operating parameters are changed only while the scene changes are occurring. Nuisance rejection parameters control the amount by which the operating parameters change. Testing was performed to determine the optimal operating point of nuisance rejection parameters for each system. Detection capability and the amount of nuisance alarms were monitored during these tests.

Intrusion crossings during cloud shadow movement in perimeter zones 1 and 2 were video taped. The intrusions consisted of walk, run and side crawl crossings at various distances from the camera. Cloud shadow movement without intrusions were also included on the video tape. The cloud shadow data without intrusions was approximately 20 minutes long.

On each VMD system, the video tape was played 6 times at each of various nuisance rejection parameter settings. Sensitivity settings that were determined in the static detection tests remained constant. Detection and the number of alarms due to cloud shadows were logged.

Results of these tests showed detection capability somewhat reduced during cloud shadow movement. Detection of run and side crawl crossings were affected the most. The reduction in detection occurred only while the cloud shadow was moving through the video scene. When a cloud completely covered the scene, the scene returned to a static condition and detection was no longer reduced.

Additional factors influencing detection capability during cloud movement were observed. These were: intensity of the cloud shadow, velocity of the intruder and timing of the intruder. Darker cloud shadows caused poorer detection than lighter ones. Run crossings at the cloud shadow front was poorer than either side of the shadow front. The cloud shadow front is defined as the area in the scene where the light-to-dark transition exists.

Figures 6, 7, 8, and 9 are graphs of cloud shadow alarms and detection capability versus global nuisance rejection parameters for the two DAVID systems, Geutebruck and Sas-Tec. The graphs are overall results of all tests at all the various distances with a particular cloud activity. Different cloud activity would more than likely produce slightly different results.

The dashed line indicates the setting of the global parameter that was chosen for minimal cloud alarms while maintaining a fairly high, but reduced detection capability.

The Wisco system does not have global change rejection. Detection capability during cloud shadow movement was the same as the static scene tests. Alarms occurred on most of the cloud shadows during the tests.

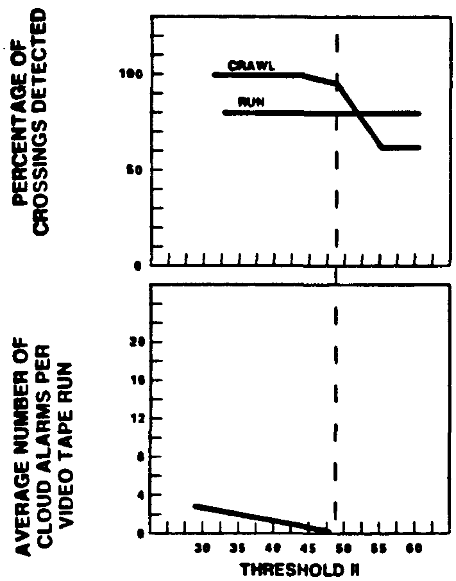


FIGURE 6. **DAVID STD**

DETECTION TESTS DURING CLOUD MOVEMENT (THRESHOLD I=25) ZONE 2

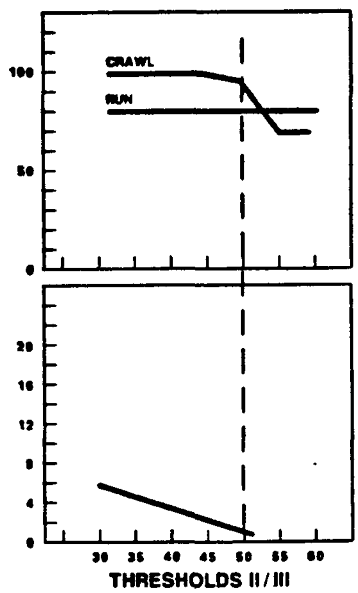


FIGURE 7. **DAVID OMD**

DETECTION TESTS DURING CLOUD MOVEMENT (THRESHOLD I-25) ZONE 2

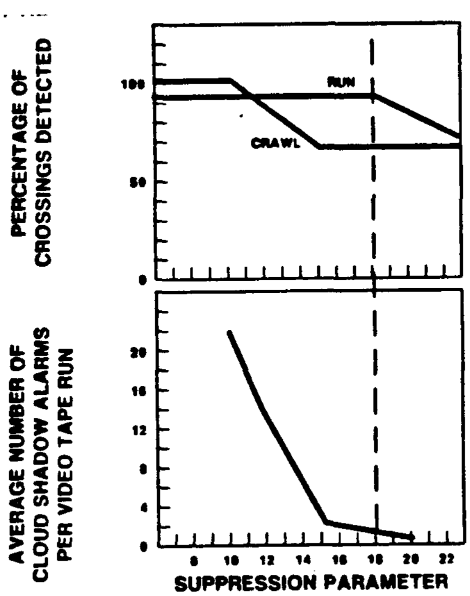


FIGURE 8.

GEUTE BRUCK VS-30

DETECTION TESTS DURING CLOUD MOVEMENT (MOTION THRESHOLD = 10) ZONE 2

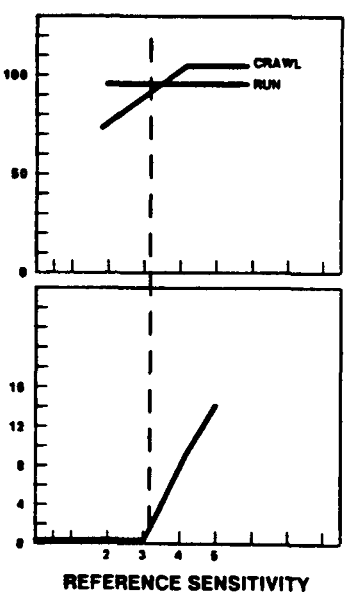


FIGURE 9.

SAS-TEC VSM-210

DETECTION TESTS DURING CLOUD MOVEMENT (DETECTION SENSITIVITY-3) ZONE 1

Nuisance alarm data. Nuisance alarm data was collected during late winter, through spring. Approximately half of the time, data was collected using the perimeter zones, with the other half using the bunker area. Weather during this period has been mild with very little moisture. The most dominant weather factors concerning video motion detection thus far at the site has been cloud activity and wind causing blowing dust.

Nuisance alarm rates varied between the perimeter zones and the bunker area, with the bunker area having a higher NAR. Figures 10, 11, 12, 13, and 14, show the average number of alarms per day for each system in each area. The number of alarms are separated by daylight hours and nighttime. Specifics concerning the listed nuisance alarm items are discussed in the following paragraphs:

ZONE 1 - Sas-tec system. (Detection area ends at 50 feet horizontal FOV width.) Animal alarms were caused by jack rabbits and dogs. An assessment of unknown was used when nothing could be seen on the video tapes for the cause of alarm. Dust entering the zone was generated by either vehicles moving nearby or by strong winds. Vehicle alarms at night were caused by the headlight beams from vehicles outside the zone.

ZONE 2 - Standard and OMD DAVID, Geutebruck and Wisco. (Detection area ends at 100 feet horizontal FOV width.) Alarms due to animals, dust, vehicles and unknown had the same specifics as in Zone 1. Specifics concerning cloud shadows, birds, area lights and slow shadows were different depending the VMD system.

Cloud shadow alarms on both DAVID versions and on the Geutebruck system occurred primarily at the end of the zone where uneven terrain exists. When cloud shadows moved through zone 2, contrast changes occurred horizontally across the uneven area. This effect appeared to the VMD systems as motion across the zone.

Cloud shadow alarms on the Wisco system occurred when clouds caused enough contrast change in the scene. When these alarms occurred, most of the detection area would be in alarm.

Birds flying slowly through the scene caused alarms on both DAVID versions and Geutebruck. Birds flying close to the camera, moving ~~fast~~ rapidly through the scene did not cause alarms. Wisco alarmed on both fast- and slow-moving birds.

Area lighting alarms occurred on the Wisco system in the morning when the lights turned off.

Alarms due to slow-moving object shadows at sunrise and sunset occurred on the DAVID OMD. All of the alarms involved vertical detection. The OMD vertical and horizontal tracking algorithms operate separately. As in the standard DAVID, there is a dawn/dusk factor which allows adjustment of the minimum horizontal detection velocity. The dusk/dawn factor when adjusted for a minimum horizontal velocity of 1.3 inches per second, eliminates horizontal slow shadow alarms. The OMD has separate adjustments for the minimum vertical detection velocity. To eliminate the vertical slow shadow alarms, the minimum vertical velocity must be set fairly high in cells covering the areas furthest from the camera. During this initial testing of the prototype OMD, a minimum vertical detection velocity of 5 to 6 inches per second was desired. This vertical velocity setting combined with the vertical tracking threshold set at 3, resulted in one or two slow shadow alarms occurred per day.

Previous testing of the standard DAVID in Zone 2 resulted with a much higher nuisance alarm rate. Major alarm sources during the previous testing were slow moving object shadows at sunrise and sunset, and effects of the uneven terrain during camera motion and cloud shadow activity. A large reduction in nuisance alarms has been obtained by the following factors: 1) New standard DAVID firmware has eliminated the slow-moving shadow alarms, 2) Using a much sturdier camera mount eliminated wind-induced camera motion, 3) Repositioning the detection area so that fewer cells cover the uneven terrain.

Most of the cloud alarms that did occur in these most recent tests, occurred in the cells that still covered the uneven terrain. In order to maintain the same detection in the zone as in the previous testing, a few cells had to remain along the uneven area.

BUNKER AREA - OMD DAVID, Geutebruck, Sas-Tec and Wisco. (Detection area ends at 48 feet horizontal FOV.) Specifics of alarms due to animals, birds, dust, and slow shadows were the same as in Zone 2. Vehicle alarms were caused by vehicles moving in front of the bunker and vehicle lights at night. Specifics of cloud shadow alarms and area lighting alarms depended the individual VMD system.

Cloud alarms on the OMD DAVID in the bunker area were not caused by a global brightness change. What did cause alarms was the effect of high contrast object shadows fading in and out when cloud shadows moved through the scene. Present in the bunker scene are a number of high contrast features (see Figure 4). One type of high contrast feature is the shadow cast by the 2 foot retaining wall in front of the bunker, and the protrusion at the door area. As a cloud moved through the area these shadows would disappear and reappear. Alarms occurred along the shadowed areas.

Most of the cloud alarms in the Sas-Tec system occurred during slower more intense cloud shadows. It was observed that when a cloud moved through the scene, the bright areas got momentarily brighter. This effect was due to operation of the camera auto-iris lens. Camera averaging characteristics causes the lens iris to open when a cloud shadow moves into the area. Bright areas not yet in the shadow get brighter until the shadow completely covers the scene. Alarms occurred in the bright areas while they were increasing in brightness.

Specifics of cloud alarms on the Wisco system were the same as in the perimeter zone. Generally, the entire detection area went into alarm due to the brightness change.

Effects similar to clouds occurred at night due to the sodium type lighting. The high pressure sodium lighting takes approximately 5 minutes to reach full intensity after power up. Areas within the scene reflect light differently. These areas changed contrast differently when the lights were increasing in intensity. Also, during the increasing light level some shadows begin to appear. Alarms occurred on Both DAVID and Sas-Tec while the lights were increasing in intensity.

As in the perimeter zone, when the lights turned off in the morning, the Wisco system alarmed.

FIGURE 10. Zone 1 Sas-tec day and night nuisance alarms.

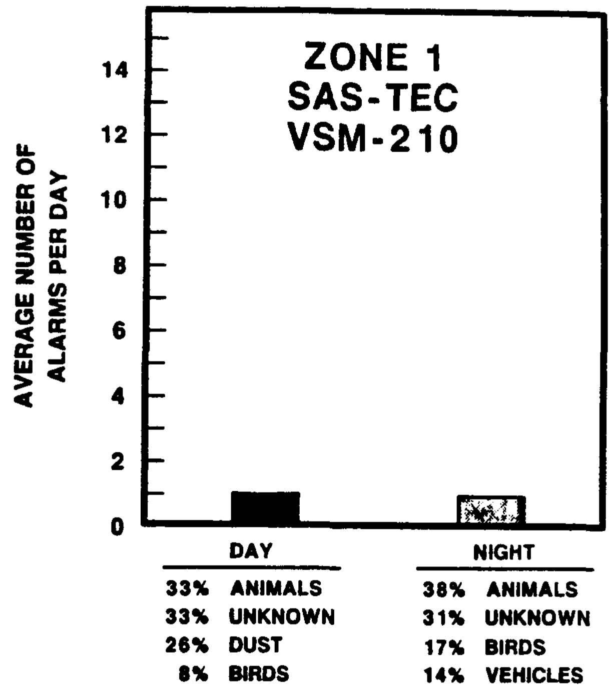


FIGURE 11. Zone 2 day nuisance alarms

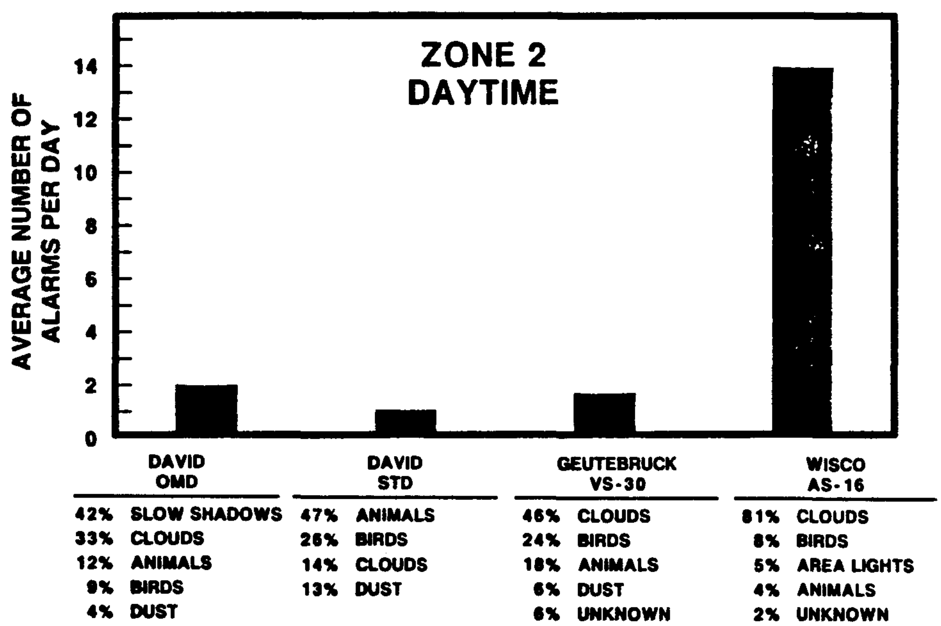
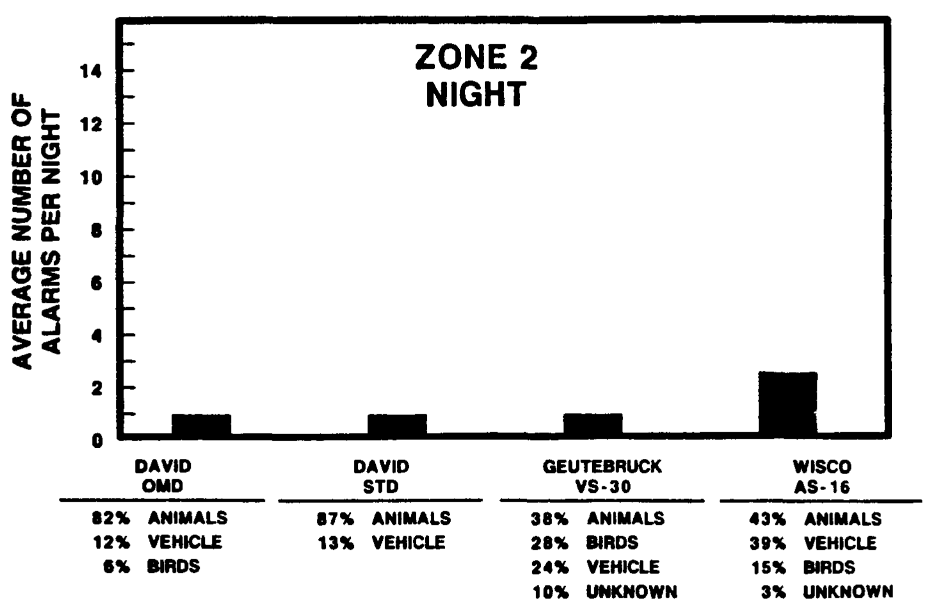


FIGURE 12. ZONE 2 night nuisance alarms.



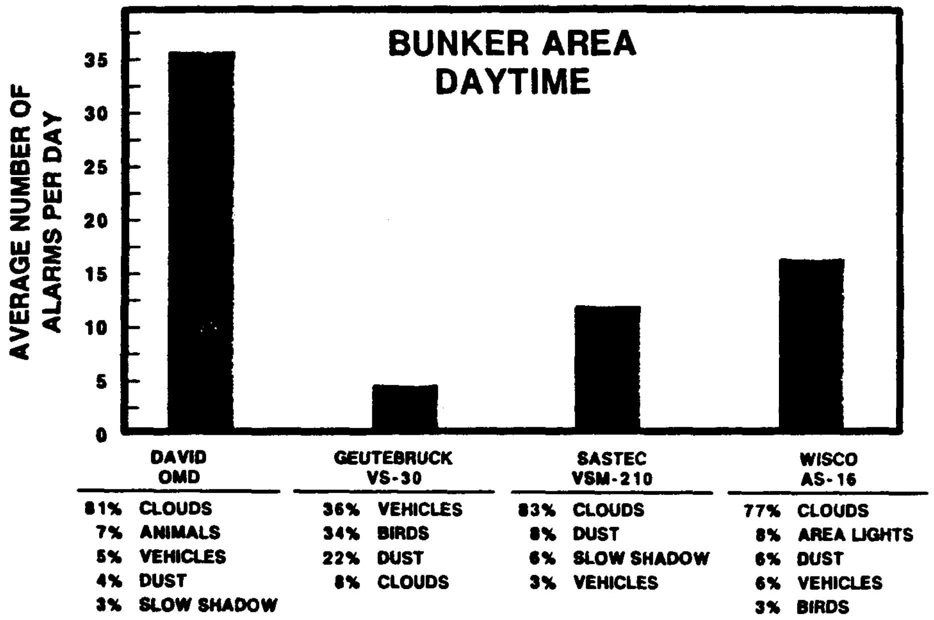


FIGURE 13. Bunker day nuisance alarms.

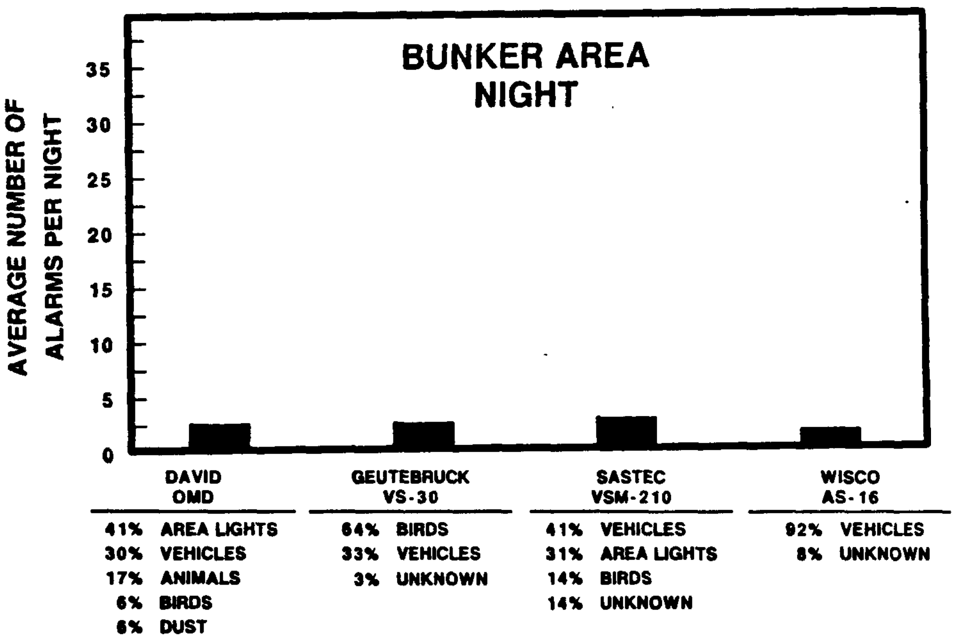


FIGURE 14. Bunker night nuisance alarms

CONCLUSION

These tests are a continuation of new VMD system evaluations. Features in VMD systems seen in previous testing and in these tests can reduce nuisance alarms in an exterior application. Effective nuisance alarm reduction features include: pre-alarm tracking, velocity/size filtering and global filtering. Perspective compensation enhances exterior performance because of the generally greater (than interior applications) detection distance and area. Use of different modes which allow fast switching of operating parameters is seen as another enhancement for exterior VMD. As an example, different sensitivity and nuisance parameters can be programmed for day and night operation.

Use of VMD, or a particular VMD system, in an exterior application must involve careful considerations. Items such as camera field-of-view, target size at furthest detection distance, target-to-background contrast are a few items to consider when choosing VMD for a particular application.

Other application considerations include features of the area being covered for detection, CCTV cameras, lighting, insect/bird population, fog or heavy snow fall. In this evaluation and the previous evaluation, a featureless area with the least amount of contrast changes resulted with the lowest NAR. Stable camera supports are highly recommended. This will reduce the probability of camera motion nuisance alarms. Camera supports and mounts are available which are very stable in the wind. Proper lighting for CCTV camera night operation is necessary. Areas that are excessively bright and dark, or cameras that are not sensitive enough, will more than likely result in poor night VMD performance.

For high security applications video motion detectors should not be used as a sole sensor. At sites where VMD is considered appropriate, VMD may be a good candidate as one of a combination of sensor types.

FUTURE WORK

Testing of these VMD systems is planned to continue. Longer term nuisance alarm data gathering will provide additional data under other types of weather conditions such as rain or snow.

Feedback to individual VMD manufacturers concerning problems or recommended improvements has been on going and will continue. As an example, the manufacturer of the omni-directional DAVID system has been contacted concerning the fading shadow nuisance alarms in the bunker scene. Other VMD representatives or manufacturers have visited the test area concerning their systems.

REFERENCES

1. Malone, T., "Exterior Field Evaluation of New Generation Video Motion Detection Systems", INMM 29th Annual Meeting Proceedings, Volume XVII, June 1988

*This work was supported by the U. S. Department of Energy under contract #DE-AC04-76DP00789.