Securing Critical Infrastructures with Laser Radar Sensors

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In recent years, the circle of threats for gas platforms, critical infrastructure, air and sea ports and the borders of the country was expanded.

I would like to point out, two, of the many other threats - The first one due to gas exploration in the Mediterranean sea and the expansion of "economical water" of Israel, and second one concern to the threat of Drones. The need for detection, identification and securing critical infrastructure, led to clear definitions, regulations, and accelerated development of unique technologies and products.

The American Presidential directive PDD-63 of May 1998 set up a national program of "Critical Infrastructure Protection" and the equivalent "European Programme for Critical Infrastructure Protection" (EPCIP) defines the sectors & facilities which are considered “critical infrastructure”.

This category of infrastructure includes:

- Energy related sites such as Power Plants, Nuclear Reactors, nuclear material and waste disposal sites.
- Defense and Chemical plants.
- Bridges and Dams.
- Drinking Water and Water Treatment facilities

Those critical infrastructure sites are exposed to terrorism acts which arise from under covered intrusion which can be grouped in 3 categories:

- Human Intruders: walking, running, crawling and swimming
- Small Ground and Sea manned and unmanned vehicles
- Aerial Penetration by Low RF Radar / Optical Signature objects: Mini Drones and Parachutes

I would to emphasize why Laser Radar Technology and especially, Dr Frucht Systems Ltd (DFSL) products suit the task of securing Critical Infrastructures.

Sea Ports, Airport and Space Missile Site



Whenever possible, the critical infrastructure will be surrounded by physical security fence or walls. Those fences may increase significantly the time which is required for penetration, but at the end of the day, he will penetrate. It can be stated that, whenever the intruder can “touch” the sensor, it is a matter of time until he will defeat it. The intruder can also penetrate by jumping over the fence or cross it by using a mobile crane or by digging under the fence. Seismic sensors offer a solution for detecting digging of tunnels. However, we need also a technology which can cope with the 3 “over the ground” intrusion categories which were mentioned above. Please see in following what should be the attributes of such a technology and to which extent the Laser Radar Technology is appropriate for the discussed tasks:

- *Enable defining sharp and accurate detection borders.* It is required due to several reasons. Sometimes people are allowed to be very close to the fence or, when the sensor is used for area surveillance, the user allows walking along a given path only. The border should be thin and accurate. When using technologies which are based on the analysis of the analysis of the video shadows of objects in the “allowed” area will “cross” the border and appear in the “forbidden area” and may be taken as true alarms. Thermal cameras will

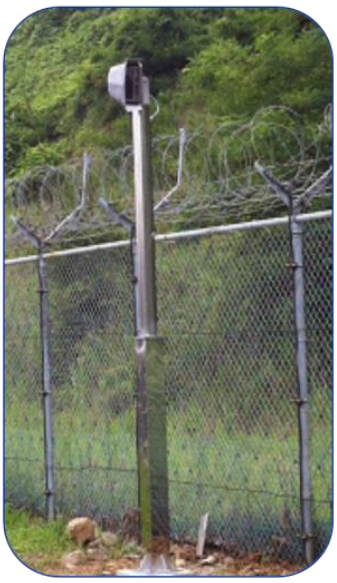
minimize this effect but they have other weaknesses which will be discussed later.

- *Detection non depending on clutter / background*. The basic component of any Laser Radar Sensor is a High Frequency (PRF) Laser Range Finder which measures the distance from the sensor to the intruder. Subsequently, this distance is compared to the previous measurements and, when the detection is based on algorithms, the distance to the intruder is compared to the distances to the intruder vicinity. Therefore, a Laser Radar Sensor works as a "stick of a blind man" and as such, he is not affected by the clutter, background or any changes in the illumination regime.
- *Detection not depending on inclination to the ground*. The performance of RF active radars is highly dependent on the beam inclination from the horizontal. The best performance is when the inclination is small, i.e., few degrees. By increasing the inclination, the signal produced by the clutter increase and when approaching vertical, the detection drops to zero. When you want to detect intruders close to the fence, geometrical constrains demand high inclination angles and therefore, due to the above reason, their detection becomes very poor and makes them irrelevant for this type of application. According to the previous paragraph, the Laser Radar sensors are not affected by the inclination and the user can place the Laser Curtain far or at close vicinity of the fence.
- *Detection not depending on the temperature*. The thermal cameras sense the difference in temperature between the intruder and the surroundings. They are very efficient for man in the loop area surveillance, especially when they are integrated with day/night cameras. They also solve problems in Video Automatic Detection because they are much less sensitive to changing in illumination, moving shadows etc., than the day night based VMD or Video Analytics. However, when the intruder clothing temperature becomes close or identical to the environment , such as after walking in rain or desert , its detection becomes very difficult and may drop to zero (depending on the camera sensitivity). The Laser Radar sensors are not affected by the temperature.
- *Detection not depending on weather and visibility conditions*. This point is a weak point of the Laser Radar technology. The laser radiation is absorbed, dispersed and reflected by the rain or any aerosol drops (such as fog). However there are methods of diminishing the effect of the weather / visibility conditions on the Laser Radar performance. Those methods are specific to any Laser Sensor manufacturer. **Dr. Frucht Systems Ltd (DFSL) uses a proprietary method of integrating the analog design of the Laser Range Finder receiver with a digital method of analyzing the returned pulse.** The results of the analyzed signal are subsequently forwarded to the algorithm which performs an additional level of

analysis. This method results in a significant reduction of the effect of fog and heavy rain.

- *High Resolution*. The Laser Radar provides high resolution and accuracy in the location, i.e. distance and angle, of the intruder. For example, **DFSL Laser Radar sensor locates the intruder at an angular resolution of 1-2 mrad and distance resolution of 0.1 m and less. In DFSL Laser Radar sensors, this resolution is used by the algorithms to filter out unwanted alarms which may arise from moving vegetation, birds, deposit of snow etc.**

Securing Fences of Power Plants and Sensitive Bunker


The Laser Sensors which are manufactured by Dr. Frucht Systems Ltd (DFSL) have additional special attributes which facilitate their use and integration in protection of Critical Infrastructures**. Most of the following attributes are due the proprietary algorithms which is the "brain" of the sensor.**

The first stage of the DFSL Laser Sensor is the learning phase. In this phase the sensor builds a map of the environment. Subsequently, **the algorithm continuously asses the changes in the environment and adapts the detection thresholds. Target is declared as valid when the detection thresholds. Due to the accurate location of the intruder, DFSL algorithm enables Automatic Smooth Tracking of the intruder by PTZ camera. The algorithm allows the user to change the sensitivity parameters, zones of interest and any other sensor parameter from the control room.**

The analog design of the DFSL Sensors Laser Range Finder and its integration with the algorithm, allow detection in marginal conditions such as: sensor pointed toward the Sun and very low reflective targets such as the clothing of Special Forces.