Potential Applications and Effects of Non-Lethal Weapons

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This presentation starts with the common definition of Non-Lethal Weapons (NLW). The potential physical mechanism for NLW-applications are described. This leads to various user applications for different scenarios. A short overview is given with respect to actual available NLW systems.

On principle, NLW's are divided into four categories: Macroscopic effectors like rubber bullets, substance effectors like tear gas, energetic effectors like high power microwave generators and manipulated information like computer viruses. These categories are described in their subdivisions with respect to their effects on target groups, their usability and the remaining lethality.

It is shown that one of the most critical items of NLW's is their dosage. Some of these possible non-lethal effects will turn into constant injury or even lethality when they were overdosed. According to a down select process a selection of applicable physical effects and effectors is presented.

Multipurpose Launcher for Non Lethal Effectors

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The need for multipurpose launchers with replaceable non lethal effectors like nets, pepper, markers or tear gas has rapidly increased due to an adequate tool to act or react within an appropriate matter in order not to provoke an escalation in a peacekeeping situation.

This presentation describes the development of a multipurpose launcher system for non lethal effectors for a distance between 25 and 300 meters. It is based on the size of the Panzerfaust III and is a reaction free launch tube with a 90 mm calibre. The effector-weight is round about 1 kg at a total projectile mass of 1,7 kg. The launch velocity is 100 m/s.

As one of the most difficult non lethal effectors, the net effector development with a diameter of 9 meters is shown in principle and also it's deployment in a complete system launch during system tests at a German proving ground.

Comparison of Threshold and Destruction Levels at a Generic Electronic Device irradiated with UWB and NNEMP Pulses

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The potential for high-power microwaves (HPM) and ultra wide band (UWB) weapons has increased due to advances in source technology and the increased vulnerability of targets because of widespread use of solid state electronics. HPM weapons are sources with extremely high power RF sinus at some fixed frequency, whereas NNEMP and UWB sources radiate at a much wider band of frequency and thus ensure that some pulse energy is at a frequency to stimulate system resonances that can effectively couple to an electronic system.

Although the pulse energy of a NNEMP is much higher compared to an UWB pulse, the radiated spectrum is limited to the lower frequencies. For smaller systems which may be additional partly shielded (i.e. computers, missiles) an UWB source seems to be more suitable to couple into slots and antenna-like apertures determined by the system.

The presentation describes a comparison of the threshold and saturation levels of a missile like generic electronic system and the experimental damage results of an unshielded microprocessor board irradiated with NEMP and UWB pulses. The test results are explained in a causal correlation to the specific spectral energy densities (J/m²/Hz).

Methodology and Results of System Simulation from the Farfield to Circuit Level at HPM Radiation

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This presentation describes a methodology to predict the generated distortion effects in electronic circuits caused by HPM radiation. For the calculation of the coupling behaviour from the freefield to the inner structure of a system and the determination of the induced currents on signal wires a FDTD simulation tool is used. Reasonable results are only available for the correct termination loads of the wire, that are specified by the frequency dependant and in general non-linear input impedance of the connected electronic circuit. These impedance is considered as scattering parameters as a function of amplitude and frequency, measured by a network analyser and the implemented in the FDTD analysis.

Using a network simulation tool the induced currents and voltages are treated as additional independent input sources. The critical aspects of network modelling are the high simulation times resulting from the calculation of the High Frequency – Low Frequency conversion products. However, the main challenge is the implementation of high frequency suitable models.

Another way is to use the calculated induced currents from the FDTD and to create a direct current source with identical frequency characteristics. Then, threshold values and burn-out values of electronic components can be determined experimentally. This enables the forward and backward system simulation to find out the susceptibility system behaviour.

Compact HPM and UWB Sources using Explosives - The Potential of Future non-lethal Warhead Systems

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The consideration of semiconductor destruction levels at irradiation exposure and RF-power levels for effective electronic distortion in combination with output-power and energy of HPM and UWB sources give a first overview of the achievable source-sink distances (SSD).

In contrast to stationary sources non stationary system enable to enlarge the effective distance. To deliver the primary electrical system energy explosively driven HPM and UWB source concepts are considered with regard to conversion efficiency, performance, weight, volume and directivity.

The energy density (J/m^2) of the radiating field necessary for a burn out in specific irradiated electronic systems is extremely lower for an UWB-pulse than for a HPM-pulse. Given a fixed amount of primary source-energy UWB-sources will reach a longer SSD than HPM-sources.

The pulse length dependent break-through-fieldstrength in air and in the sources itself limit the maximum source output power at UWB and therefore limit the absolute SSD for a given irradiated device. To overcome this limit in UWB a pulselength reduction has to take place - in HPM a pulselength extension.

A comparison of usable devices and typical arrangements are presented as well as potential targets at the battlefield and the scenario to create burn-out and interference. The conclusion derive the potential carrier platform from the advantage of an electromagnetic field as a non lethal weapon with its specific illumination area and hit accuracy.