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Use of barrage balloons and blimps equipped with conductive tethering ropes and nets as C-UAS kinetic and RF weapons

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Information about Company

History and short historical description.

Optoprofiler LLC has been created by Dr. Wojciech Walecki and his son Dr. Peter Walecki on January 1, 2019. Optoprofiler LLC builds Optoprofiler 200 a 200 mm scanning tool for wafer thickness and film stress for semiconductors, precision machining, and characterization of high aspect ratio complex MEMs structures. Optoprofiler LLC also represents companies manufacturing sensors for high aspect ratio structures, Atomic Layer Deposition (since 2023), and endpoint detection in dry and wet etch processes (since 2022), and Fringe Resolved Tomography tools (since 2022). Company was built using experience gained when operating fringe projection tomography company called Sunrise Optical LLC which assets it purchased.

Company capabilities: Company has basic optical, electronic, and mechanical prototyping capabilities including

- Basic machining tools including manual and CNC milling machines, drill press, set of various hand tools, metrology tools, tools for assembly, and fixtures for machining of aluminum extrusions.

- Basic low voltage, low power electronic shop. electronic assembly capability including soldering station, scopes, voltmeters, soldering station, PCB design and manufacturing capabilities.

- Basic optical systems assembly and alignment tool, including interferometers, optical flats, (single mode) fiber tools, optical lasers.

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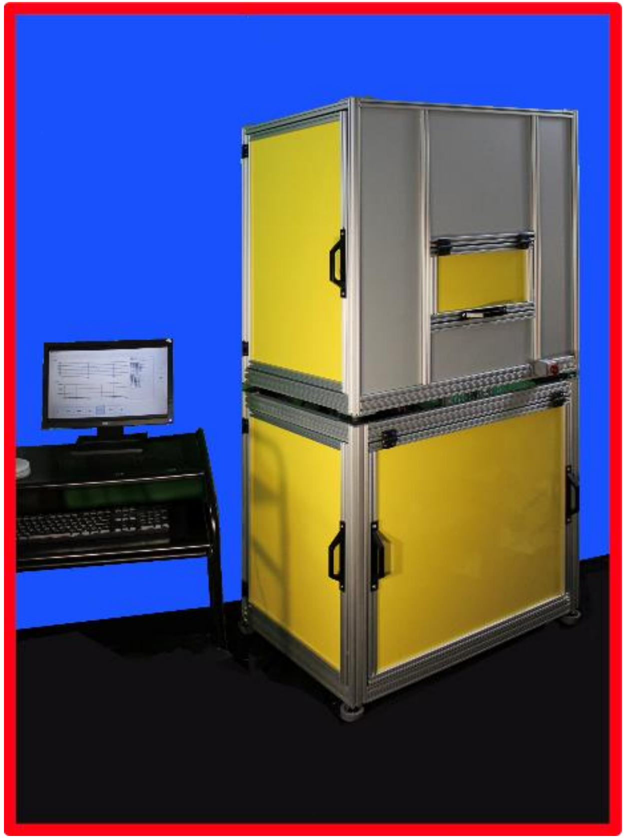
Description of Optoprofiler 200 tool

The alpha version of the tool exists and is shown on the right. Basic tool specifications as currently available are shown in Table 1. The tool has simple modular construction, where modules reside in a 19-inch rack. For more information on technology please see PowerPoint presentation available upon request.



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hybrid war

Introduced by Giewrasymov [11-12] concept of hybrid war is characterized by variety of subthreshold operations.

- Experience in annexation of Crimea
- Air space and land space violations on boarders with NATO members
- Use of migration as a weapon

Before we delve into the concept, it is important to highlight that hybrid warfare in the contemporary era became increasingly popular in policy debates following two important developments. First, in 2005, two US military officials wrote about the "rise of hybrid wars" and emphasised the combination of conventional and unconventional strategies, methods, and tactics in contemporary warfare as well as the psychological or information-related aspects of modern conflicts. Second, Russia invaded Crimea in 2014 and achieved its objectives by virtue of conflating "deniable" special forces, local armed actors, economic clout, disinformation, and exploitation of socio-political polarisation in Ukraine. [13]

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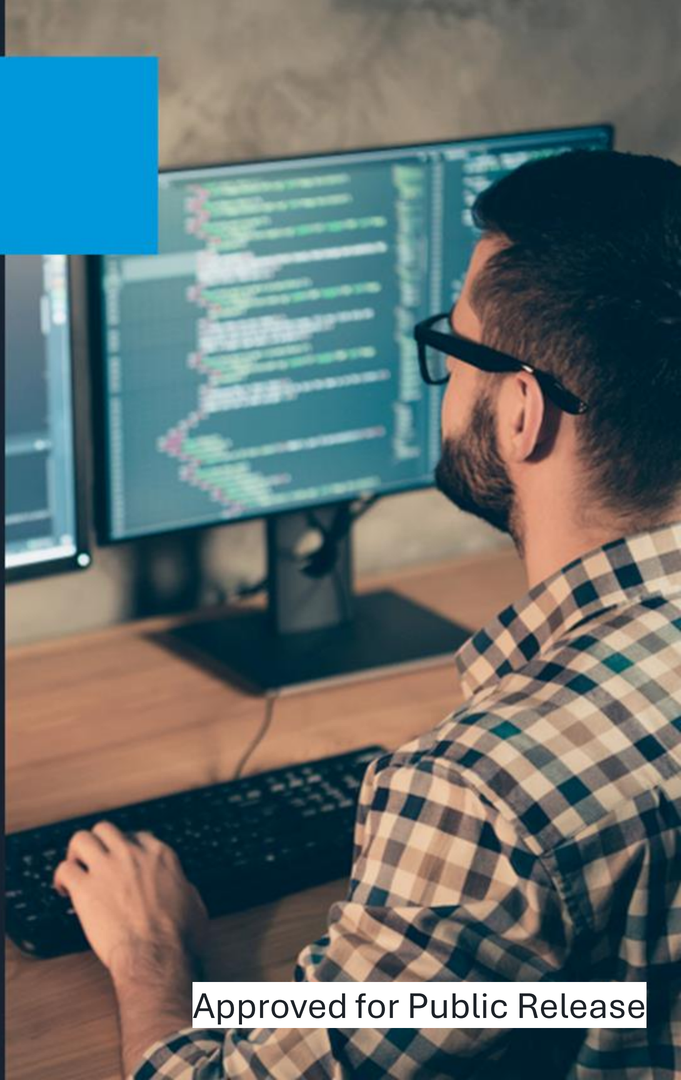
Subthreshold Aerial Border Threats

We observed in the past (last10 years on Polish eastern borders) the use of Hybrid Warfare sub-threshold aerial border threats including:

1. “Stray” drones
2. “Stray” helicopters
3. “Stray” guided and ballistic missiles (first deadly civilian casualties recorded)
4. “Stray” meteo-observational balloons
5. We also anticipate the use of light aircraft by infiltrators as it was applied in Israel

The typical attack is correlated in time with adversary other activities (such as the bombardment of targets in Ukraine, military exercises in Bialorussia, or stimulated unrest of the refugees on the border.

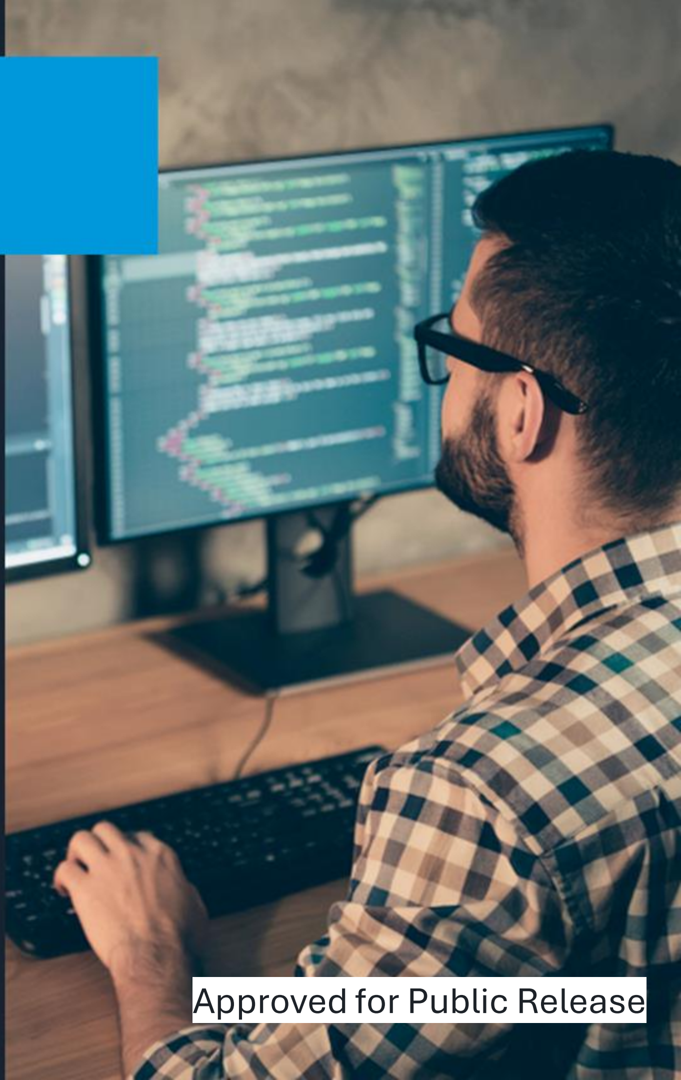
The aircraft usually flies at low altitudes making radar detection difficult. In one case stray rocket flew at a depth exceeding 100 miles and was located several weeks later.



Subthreshold Aerial Border Threats

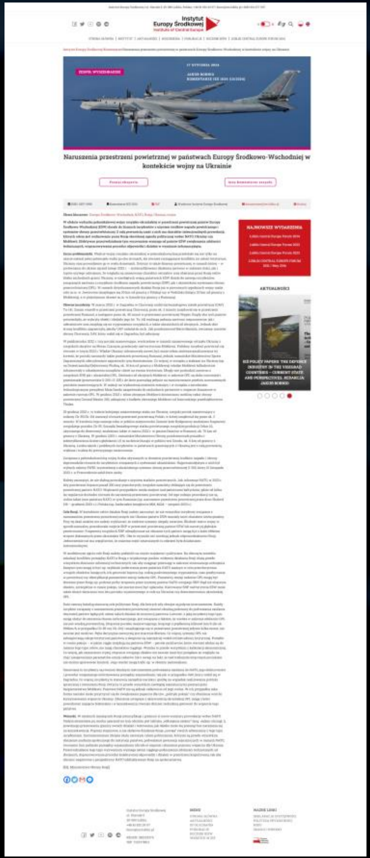
The use of these weapons provides the following benefits to the adversary

1. Psychological constant pressure on the civilian population
2. Provide intelligence information about order defense facilities
3. Provide intelligence information about reaction of military and civilian state defense structures
4. Provide information about attitudes and morale of military and civilian population



[Naruszenia przestrzeni powietrznej w państwach Europy Środkowo-Wschodniej w kontekście wojny na Ukrainie | Instytut Europy Środkowej (ies.lublin.pl)] [14]

Violoations of airspace in Central and Eastern Europe in context of War in Ukraine (Instute of Central Europe)



Main Solution addressing this type of threat

We propose the use of inexpensive balloons and blimps flying at an altitude of about 200 m and connected by a metalized wire network.

Furthermore, nets acting as RF-emitting antennas would be used to disrupt RF signals controlling drones, including GPS signals. We show by quantitative simulation that shielding and disrupting effects are present on both sides of the wall.

The stationary barrage balloons and blimps have been widely used as defensive – and in case of bombarding blimps and balloons during the first and second world war [1,2].

Main Solution addressing this type of threat

Currently, a variety of aerostats and airships are adaptable for military use available [3]. In the case of tethered balloons and blimps, one can use the steel lines as a weapon blocking access of enemy manned and unmanned low-flying aircraft to their land-based targets. In the past usually, steel cables were used as a mechanical barrier to enemy aircraft [4,5].

Balloons and blimps are used as platforms for radar antennas, and RF reflectors [6]. The barrage balloons were also used in Ukraine [7,8].

In the paper, we discuss the performance and cost of the balloon-suspended finite-size conductive net as the shield of RF signal using EM diffraction theory [9-10]. We discuss the case of grounded, RF-energized, and high-voltage-powered nets for the neutralization of small and large drones.

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20-foot Blimp Shape Giant Advertising Balloon - Two Color Custom Artwork - Balloon Ideas

Description

- Multiple use blimp made from 18-mil thick PVC fabric with a UV inhibitor to protect from fading
- Ideal for indoor use (Great for Trade Shows and Exhibits) and limited outdoor use (can handle wind gusts up to 25MPH)
- Package includes: 20-foot blimp, your choice of rigid tail fin colors, attached harness ropes, 125-foot tether line, 5-foot inflation hose with brass fitting, minor repair kit and instruction manual
- Each inflatable is custom made -- please allow three weeks of production time
- Complex artwork may require additional artwork charge
- Requires 750 cubic feet of helium for proper inflation
- Net lift 22 pounds

The difference in the up and down force is 0.069 pounds. Therefore each cubic foot of helium could lift 0.069 pounds. In order to lift 100 pounds (which would include the weight of your load, the balloon, and the helium) you would need 1449 cubic feet of helium.

We calculate 0.5 m square net made from fishing line.

The mass of such net (200 m tall is 0.2 kg/m).

I-2 blimps could support 50-100 m of the 200 m tall wall

Cost <$10000 /100 m (gas not included)

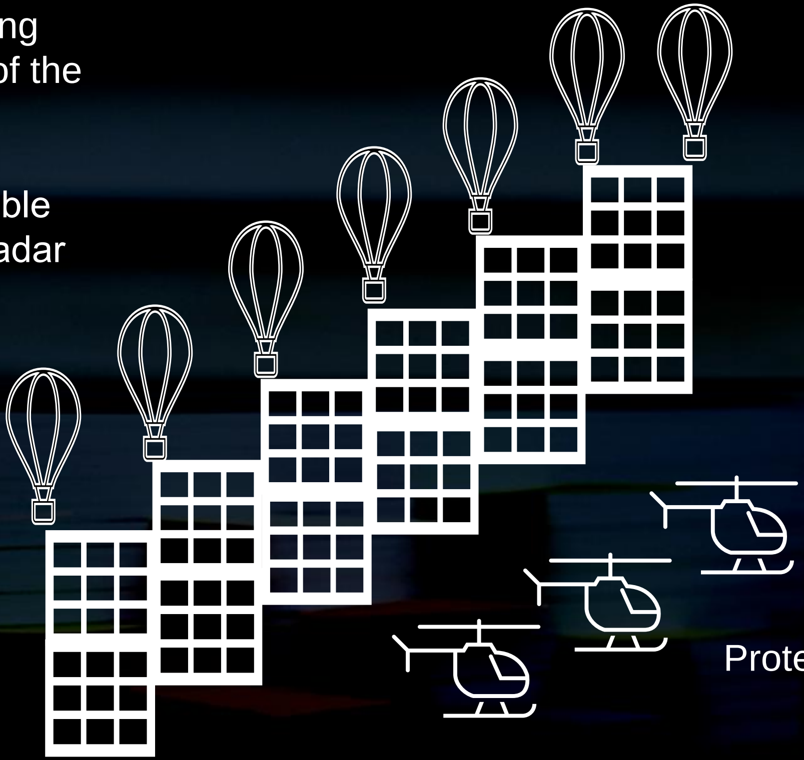
Network strong enough to stop 50 kg drone

Radar Barrier

A conductive grid is reflecting radiation having wavelength longer than about half the size of the grid.

Shadow from the barrier produces an “invisible zone” where for the ground or low altitude radar when we can place our assets.

Adversary radar



Protected assets

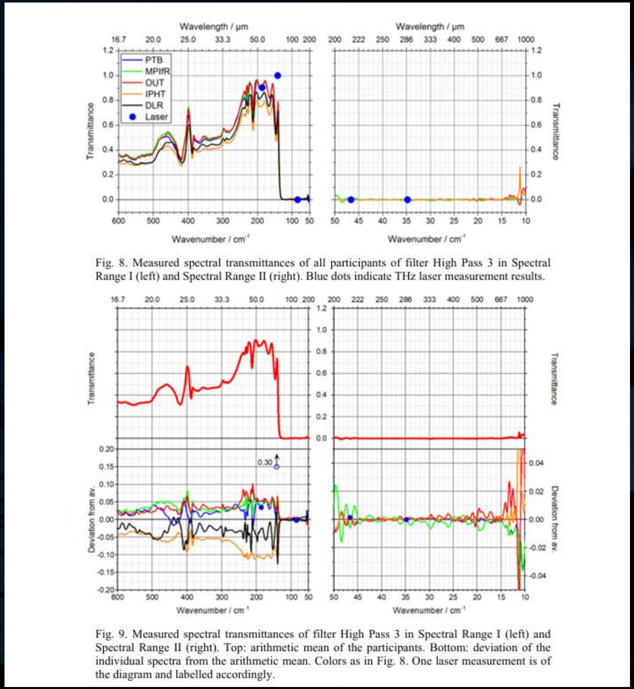
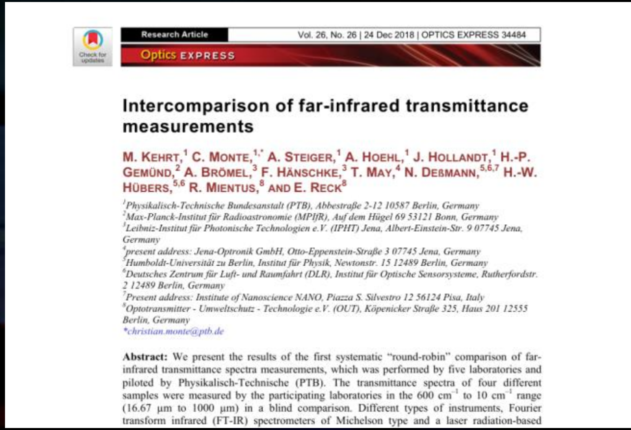


Fig. 8. Measured spectral transmittances of all participants of filter High Pass 3 in Spectral Range I (left) and Spectral Range II (right). Blue dots indicate THz laser measurement results.

Fig. 9. Measured spectral transmittances of filter High Pass 3 in Spectral Range I (left) and Spectral Range II (right). Top: arithmetic mean of the participants. Bottom: deviation of the individual spectra from the arithmetic mean. Colors as in Fig. 8. One laser measurement is of the diagram and labelled accordingly.



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Intercomparison of far-infrared transmittance measurements

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Abstract: We present the results of the first systematic "round-robin" comparison of far-infrared transmittance spectra measurements, which was performed by five laboratories and piloted by Physikalisch-Technische (PTB). The transmittance spectra of four different samples were measured by the participating laboratories in the 600 cm^{-1} to 10 cm^{-1} range (16.67 µm to 1000 µm) in a blind comparison. Different types of instruments, Fourier transform infrared (FT-IR) spectrometers of Michelson type and a laser radiation-based

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Radar Barrier, II

A conductive grid is reflecting radiation having a wavelength longer than about half the size of the grid.

A conductive grid can be uesd as radar antenna
Or phase array antenna for intelligence, and maskirovka purposes.

Can be also HV energized to further
Protect against small drones.

Conclusions/Advantages of our technology

- High speed for deployment – low R&D required
- Low cost – the cost of one small blimp is comparable to the cost of one drone
- Semipermanent character of the barrier – blimps can stay deployed in place for days or weeks
- Reduction of sub-threshold threats
- If the adversary destroys the barrier he escalates conflict above the conventional war threshold
- Can work in cooperation with existing radar and anti-aircraft systems

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