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Use and Potentials of Counter-Optical Lasers in Riots and Terrorism

This essay in the TRENDS counter-terrorism futures series focuses on LASER (Light Amplification by Stimulated Emission of Radiation) effects on human vision and activities in the context of riots and terrorism. Both the use and potentials of counter-optical lasers—that is, lasers utilized so as to disrupt and degrade human vision—will be highlighted with in regard to each of these forms of criminal-political activities. Additionally, a discussion of some of the applicable police and security response (countermeasures) to such laser use will be provided.

Counter-Optical Lasers

Lasers have been around since the early 1960s and have found applications across numerous scientific, industrial, commercial, educational and military applications. Other than in laser lightshows and in science fiction films, the general public was not typically exposed to lasers until the advent of laser pointers—initially, red ones and, as the technology matured and the prices drastically fell, the much brighter green ones [1]. As a result, lasers have been ubiquitous since the 1990s with present uses including barcode scanning, highlighting presentations, firearms sighting, and even as amusing cat toys. The projected 2015 market for these devices is now approaching \$10 billion dollars for the year [2].

Counter-optical lasers refer to lasers directed against biological optics (typically human eyes) and electro-mechanical devices. Relatively few *dedicated* counter-optical lasers actually exist as opposed to the millions of other laser devices—most commonly laser pointers—yet, when they do, they have been specifically designed for policing and military purposes. When used by police, such devices are meant to disrupt vision but do not typically harm the eyes of the human being targeted. The same goes for such devices used by the military in policing-like operational environments.

However, far more powerful military devices that can neutralize opposing force electro-mechanical optics (and as collateral damage do severe injury to the eyes of soldiers utilizing them) also exist [3]. Hence, laser pointers like most other types of laser devices, including the many more powerful ones, essentially *become* counter-optical lasers when directed at human eyes. This use typically takes place under nighttime conditions when pupils are more dilated and susceptible to bright light. Thus even low energy lasers, as opposed to industrial and military high energy lasers that can cut through materials or shoot down rockets respectively, are able to disrupt and degrade human vision along with negating those activities associated with it across a spectrum of increasingly severe levels of impaction.

Effects on Vision and Other Activities

At the most basic level, shining a laser at an individual can cause a startle reaction in the target which could conceivably result in injury to a driver or someone engaging in a dangerous task if it struck at the wrong moment. Also an individual may see a telltale 'red dot' placed on their chest that could raise personal safety concerns such as being sighted by a weapon. As a result, the anxiety level of the person so illuminated may immediately be raised.

The next level of disruption is that of distraction and annoyance with the laser light being shined into one's eyes. This can increase to a glare effect—similar to after of looking into the sun—if greater brightness is encountered. Tearing and watering of the eyes can then ensue if prolonged illumination takes place along with an eye burning sensation. At this point, vision is degraded, if not totally inhibited, with greater levels of severity resulting in flash blindness and afterimage effects and even eye pain. If enough energy gets into the human eye (which has a quarter second blink and aversion defensive reflex mechanism), actual corneal or even retinal damage may take place via different biological processes [4]. Luckily, most lasers encountered are of the eye safe variety and will not normally damage the eyes should one be illuminated.

Depending on the length and intensity of the lasing taking place, the effects on one's activities can be minimal through severe on the scale of visual disruption effects. It should be noted that magnifying optics—such as eyeglasses, binoculars, and conventional gun scopes—should be considered hazardous to use in a laser threat environment. They can intensify laser energy directed into the human eye and thus cause far more serious damage to an individual being illuminated by a laser beam than would normally occur. Highly reflective objects such as SWAT tactical mirrors should also not be utilized under such conditions due to specular reflection effects. Windshields and helicopter canopies also produce unique challenges when struck by lasers due to the micro-abrasions they contain, potentially resulting in opaque barriers that cannot be viewed through.

Laser devices can also be directed at security cameras to temporarily “blind” them (if targeted with weak lasers) and even potentially burn them out (when much stronger lasers are being utilized). Higher energy lasers can create a crazed glass effect in electro-optics or even start fires—though encountering such lasers in criminal and terrorist incidents would presently be an extreme rarity.

Use and Potentials in Riots

Laser pointers were first noted used in the ‘Battle for Seattle’ in November 1999 in Seattle, Washington when protestors (mainly anarchists) utilized them against responding police during the WTO (World Trade Organization) demonstrations. These were weak ‘red’ laser pointers and only caused very limited visual disruptive effects. While some discussions of laser use potentials were raised in various anarchist media following this incident and in Genoa, Italy in July 2001 an operation was even put in place to utilize 1,000 cheap mirrors for counter-optical purposes (during the G8 summit), it was roughly nine years before lasers were once again utilized in noticeable numbers in a riot type situation [5].

In December 2008 in Athens, Greece, far brighter ‘green’ lasers were utilized against riot control police in ongoing street battles with protestors who also hurled eggs, rocks, and Molotov cocktails [6]. Lasers have been used individually and in small clusters against police officers with between a half-dozen to a dozen evident in large demonstrations and subsequently directed against Greek governmental buildings. The use of such laser devices has continued in violent Greek austerity protests ever since with their use readily evident in June 2011, February 2012, and March 2015 [7].

Counter-optical laser use was also evident in the December 2012 and February 2013 protests and street battles in Egypt and even more so in the mass Egyptian demonstrations that took place in Cairo in June/July 2013. In the later protests dozens of green lasers were seen striking Egyptian military helicopters circling over Tahrir Square, demonstrating an escalation of use. A few of the newer and extremely bright ‘blue’ lasers also appear evident in some of the incident photos [8]. Besides targeting the military craft, lasers were also directed against governmental buildings, police, and, at times, opposing protestors throughout the months of civil strife.

For protestors and rioters, lasers offer superior ‘less lethal’ standoff capabilities against police forces that result in officer vision disruption and inability to perform certain tasks and an area denial capability in the case of air assets. These devices are increasingly being used in larger and larger groupings with the expectation, derived from the mass Egyptian demonstrations, that dozens of such devices may now be encountered in civil unrest scenarios.

Use and Potentials in Terrorism

Terrorists, insurgents, and organized criminals have had an on-again and off-again interest in using counter-optical lasers since the mid-1990s. The earliest known interest in using lasers for terrorism purposes can be traced back to the Aum Shinrikyo cult in Japan. This group had a proclivity for high tech and exotic weapons—like sarin gas and drones—and sought Russian scientific help in furthering the cult's research into laser weapons. In October 1994, the group built a truck mounted red gas laser that malfunctioned during the testing stage. The intent was to possibly utilize the laser against Tokyo policemen. Following this failed attempt, the cult then tried to purchase a half-million dollar laser system from a California company to no avail just prior to their Tokyo sarin attack [9].

Two incidents then took place a few days apart in October 1998 near Zenica and Tuzla, Bosnia. Counter-optical lasers were utilized by Serbian forces against U.S. helicopters, causing minor injuries to at least one of the flight crews. Based upon the circumstances of the incidents, military-grade lasers were likely involved such as non-eye safe rangefinders or illuminators. US helicopters were grounded in those areas of operations for about a week until protective laser eyewear could then be provided to the threatened aircrews [10].

In January 2002 near Fabens, Texas a US border patrol helicopter was struck by a red (or near infrared) laser coming across the border from Mexico. The laser beam originated from a vehicle belonging to individuals dressed like Mexican military personnel next to a known stash house. Given the location of the incident, it is quite likely that the perpetrators may have been Zetas, former Mexican special forces members in the pay of the Gulf cartel. The border patrol helicopter was forced to leave the area due to the intensity of the beam, likely a laser rangefinder, but fortunately the crew did not suffer any eye damage [11].

In November 2004, the FBI (Federal Bureau of Investigation) and DHS (Department of Homeland Security) issued a national bulletin that Al Qaeda or other terrorist groups might try to use lasers as weapons against aircraft [12]. This was followed in 2006 with concerns raised over radical Islamists on a forum discussing the idea of using lasers, especially green ones, against fighter jets. One participant even suggested providing laser pointers to children to aim at the jets, and another stated that they had utilized a single laser against two commercial jets forcing them to return to an airport [13].

While the validity of the last statement may be suspect—though both helicopter and commercial airliner craft have been forced to land from low energy laser strikes in some rare circumstances [14]—the terrorist potentials of the more powerful counter-optical laser devices is very real. In fact, laser weaponry offers many advantages over traditional firearms and munitions stemming from its superior capabilities: speed of light, extreme standoff ranges, no ballistics, deep clip, and other

attributes. While some mention of radical Islamist forum discussions on terrorism laser use potentials have been mentioned as late as 2014, terrorist interest in such devices presently appears to be at the off-again level. This partially stems from the fact that most terrorists are still conventional in orientation and remain focused on the knife, gun, or bomb for their attacks.

Police and Security Forces Response

Awareness and training represent the cornerstone of domestic security response to the use of lasers in riots and terrorism. Specific TTPs (tactics, techniques, and procedures) can be taught to responding officers, and even commercial pilots, along with the provision of protective eyewear as warranted. These tactics can be even as basic as using a simple clipboard to help block a laser illumination being directed at a pilot or riot control officer.

Procedures and systems also exist to help individuals be alerted to a laser strike and even trace one back to its point of origin. Initially device 'glow down' after use readily gave away the position of the perpetrator but most newer systems do not provide this signature so FLIR (forward looking infrared) and laser tracking and position identifying technologies may be required. Further, given the extreme standoff ranges of many counter-optical lasers, some sort of response capability based on the premise of fighting light with light should be considered utilizing white light (powerful spotlights mounted on helicopters) and eye safe law enforcement and military dazzling laser systems.

Ultimately, restrictions on the sales of certain lasers devices can also be implemented as well as enacting and updating criminal statues on laser use against law enforcement officers, public officials, and various forms of transportation (e.g. against drivers and pilots). Public awareness campaigns concerning the dangers of irresponsible laser use and the penalties involved for committing such crimes should also be made known. While such statues and media campaigns may not deter would-be terrorists from attempting to utilize lasers for criminal-political purposes, they may help to deter at least some individuals from utilizing them in violent demonstrations and riot control type situations or even stop some commercial aviation illuminations that might have taken place due to sheer ignorance [15].

Notes

[1] This is because "the human eye is about 50 times more sensitive to green light at 532 nm than to red light at 640 nm." See *Laser Pointer Safety Factsheet*. Environmental Health & Safety, University of California Irvine, n.d., <https://www.ehs.uci.edu/programs/radiation/Laser%20Pointer%20Safety%20Factsheet.pdf>.

[2] Gail Overton et al., "Laser Marketplace 2015: Lasers surround us in the Year of Light." *Laser Focus World*. 16 January 2015, <http://www.laserfocusworld.com/articles/print/volume-51/issue-01/features/laser-marketplace-2015-lasers-surround-us-in-the-year-of-light.html>.

[3] For information on the international ban on laser weapons meant to blind humans, see *Protocol on Blinding Laser Weapons (Protocol IV to the 1980 Convention)*, 13 October 1995. International Committee of the Red Cross, n.d., <https://www.icrc.org/ihl/INTRO/570> and *Ban on blinding laser weapons now in force*. 30-07-1998 News Release 98/31. International Committee of the Red Cross, <https://www.icrc.org/eng/resources/documents/misc/57jpa8.htm>.

[4] For background information, see "Laser Bio-effects." *Berkeley Lab*. 2 February 2015, <http://www2.lbl.gov/ehs/safety/lasers/bioeffects.shtml> and Van B. Nakagawara, et al., "Laser Hazards In Navigable Airspace." *Federal Aviation Administration*. N.d., https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/laser_hazards_web.pdf.

[5] Robert J. Bunker, "Counter-Optical Laser Use Against Law Enforcement in Athens." *Red Team Journal*. 23 February 2009, <http://redteamjournal.com/2009/02/counter-optical-laser-use-against-law-enforcement-in-athens/>.

[6] "Greek rioters use lasers against police as violence over boy's death continues into second week." *The Daily Mail*. 15 December 2008, <http://www.dailymail.co.uk/news/article-1094892/Greek-rioters-use-lasers-police-violence-boys-death-continues-second-week.html>.

[7] Dominic Sandbrook, "A crisis that could tear Europe apart." *The Daily Mail*. 17 June 2011, <http://www.dailymail.co.uk/debate/article-2004550/Greece-riots-2011-A-crisis-tear-Europe-apart.html>, "Greece: Laser pointers continue to be used in riots." *LaserPointerSafety.com*. 20 February 2012, http://www.laserpointersafety.com/news/news/nonaviation-incident_files/9826caaf1bb6ada16752c60c690fa8c2-221.php, and Reuters, "Masked youths hurl stones and use a green laser beam during clashes with riot police in Athens." *Thompson Reuters Foundation*. 17 March 2015, <http://www.trust.org/item/20150317211036-ack4p/>.

[8] Ryan Craggs, "Egyptian Protesters Bombard Helicopter With Lasers (PHOTOS)." *The Huffington Post*. 1 July 2013, http://www.huffingtonpost.com/2013/07/01/helicopter-laser-photos-egypt-protesters_n_3528371.html? and "Egypt crisis: Why are Cairo protesters using laser pens?" *Magazine Monitor BBC News*. 4 July 2013, <http://www.bbc.com/news/blogs-magazine-monitor-23178484>.

[9] Robert J. Bunker, "Terrorists and Laser Weapons Use." *Studies in Conflict and Terrorism*. Vol. 1, No. 5. May 2008: 444.

[10] Ibid: 445.

[11] Ibid: 445. Infrared laser devices represent a whole new dimension to laser threat potentials and offer a number of unique advantages for terrorist use.

[12] Associated Press, "Terrorists May Use Lasers to Blind Pilots, FBI Warns." *Los Angeles Times*. 10 December 2004, <http://articles.latimes.com/2004/dec/10/nation/na-lasers10>.

[13] "Mujahideen Use Laser Pointers to Disrupt Fighter Jets." *Islamist Websites Monitor* No. 16. *MEMRI*. 31 October 2006, <http://www.memrijttm.org/mujahideen-use-laser-pointers-to-disrupt-fighter-jets.html>.

[14] Literally thousands of incidents in which commercial aircraft in the United States have been illuminated by lasers—the vast majority of which have been laser pointers—have taken place with only a minority of aircraft immediately forced to land. Still, the FBI is increasingly becoming concerned about such domestic US lasing incidents. See, for instance, "FBI Launches National Campaign to Address Laser Threat to Aircraft." *National Press Releases. Federal Bureau of Investigation Website*. 3 June 2014, <http://www.fbi.gov/news/pressrel/press-releases/fbi-launches-national-campaign-to-address-laser-threat-to-aircraft>.

[15] For response and counterterrorism protocols, see for example Matt Begert, "Laser Countermeasures." John P. Sullivan, Ed., *Jane's Unconventional Weapons Handbook*. London: Jane's Information Group, 2000: 229-235, Matt Begert, Lisa Campbell, and Sid Heal, "Disruptive and Destructive Effects of Laser Illuminations." *FBI Law Enforcement Bulletin*. April 2008: 10-15, and Madelyn I. Sawyer and John P. Sullivan, "Laser Legal Issues: Prosecuting Perpetrators." *FBI Law Enforcement Bulletin*. April 2008: 18-21.

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