

Guest Editorial: Note that in the near future, the *Journal of Directed Energy* intends to begin accepting classified manuscripts for a limited distribution version, which will serve to address some of the concerns expressed in this editorial.

From Technology Trenches¹

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There comes a time when technology for technology's sake is not enough. There comes a time when getting more power, more efficiency, or more anything else from the latest laser is not enough. There comes a time when implementing the latest algorithm in beam control or gaining a few more decibels from microwave transmitters is not enough. In mathematical terms, while all of this is necessary, it is not sufficient to justify our continued existence. We must find a way to serve the Warfighter. We must transition our technology, some of which is very mature, to acquire the weapons Warfighters need. We must get out of the "technology trenches" and onto the battlefield. I think that time has come.

We at DEPS worked hard to bring the worlds of Beam Control, Lethality, Modeling & Simulation, and Employment together in the recent Systems Symposium at the Naval Postgraduate School. We observed detailed and intense communication and discussion. We were also happy to observe considerable cross talk among the four disciplines represented. I feel very strongly that these are the subjects that will get us out of the technology trenches. These are the subjects that have most to do with providing the Warfighter with the needed capabilities in the antiterrorist campaigns of today and tomorrow.

It is interesting, to me, that we did not spend our time discussing laser and microwave devices at the Systems Symposium. This must be one of the first major DEPS symposia for which this is true. Energy devices are certainly necessary, like the rabbit is for the rabbit stew. Energy devices are the engines of our business; but, when you buy an aircraft, for instance, there is a lot more than the engine that must be considered. In fact, I doubt that an engine, by itself, ever sold an aircraft. This analogy is imperfect but is not bad as a default for our transition viewpoint.

We have been very fortunate that for about 40 years we have had a fairly robust DE technology program. There have certainly been ups and downs, but I believe there has always been substantial funding in our business. This has required a lot of fortitude and visionary thinking from many senior leaders in DOD and the Services. The result of this funding and visionary thinking is a very broad technology base that is now ready to move in any one of several directions to serve the Warfighter. Specifically, a number of DE weapons have been recently demonstrated or are about to come on-line in a way that the Warfighter can touch and feel the technology and not be unduly influenced by "Powerpoint" engineering. Every scientist and engineer working in DE should take great pride in the technology base we have generated. While much remains to be done, we have truly come a long way in our basic understanding of speed-of-light weapons.

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For example, we have seen the demonstration of THEL successfully engaging Katyusha rockets and the impact that has had on Army DE thinking. We have seen both HEL and HPM technology engage MANPADS. In the next couple of years we will see the major demonstrations of Airborne Laser (ABL) and Advanced Tactical Laser (ATL). These experiments will show that we can integrate HEL weapon prototypes on dynamic platforms and engage targets. These systems are among the most complex that we have ever demonstrated in the DOD. We will also soon have a prototype of an Active Denial System (ADS), which can transform our approach to nonlethal warfare. And there is much more to come. In the next few years much of our technology will be demonstrated for initial weapon applications. This is occurring at the same time that new classes of laser technology are being actively pursued by JTO, DARPA, and the Services. Such improvements in the technology include increased power and better beam quality from solid-state lasers (JHPSSL) as well as the free-electron laser (FEL).

The important question to ask ourselves is, "So what?" I am not aware of any transition to acquisition or production of any HEL or HPM technology. It is not at all clear that if we "build it, they will come." We certainly must build it because demonstrations are absolutely crucial. But we must get the operator a lot more involved before "they will come." This involvement must come from all levels, including from the commanders, the staffs, and certainly the guys and gals in the trenches of warfare. I am aware that there are concerted efforts in the Services to accomplish this. They are necessary and must be emphasized and prioritized. To be parochial, one example is the Air Force's Long Range Combat Aircraft study in which the operator, Air Combat Command, is in dialog with the technologist, AFRL/DE, on DE applications. At a broader level, there is also the DE Task Force in the Air Force, wherein both defensive and offensive effects of DE weapons are being evaluated for importance. This Task Force is being led from the Air Staff by General Officers and involves senior leaders throughout the DE acquisition and operator communities.

Whether the Warfighter becomes familiar with DE technology and status from formal studies, informal talk at the bar, participation in demonstrations, symposia, or the *Journal of Directed Energy*, there are critical issues that he or she must provide for us to move forward. We desperately need critical thinking by the Warfighter on the shortfalls that DE technology can address that must eventually show up in a CONOPS or a Requirement; but first we must do the thinking. I personally doubt that the initial deployment of DE weapons will be for applications that are already being achieved by conventional weapons. I believe that the applications that will drive initial requirements are those that cannot be achieved today or, at best, can be done only at great cost and risk. Simply doing today's missions better, cheaper, etc., is interesting and ultimately important, but not sufficiently compelling to divert the resources needed to field the first DE system, in my opinion.

What are potential scenarios that might identify shortfalls that could best, and perhaps only, be served by DE capabilities? Admittedly there is danger in technologists, such as me, proposing warfighting scenarios. I would fully expect the Warfighter to label it naïve. That is okay; in fact, that is desirable if the Warfighter then comes back with the "right" scenario. But let us fearlessly press on anyhow. Consider the tactical/terrorist world. Our precision-strike weapons are so good today that once a target is identified, we almost always have the right weapon to destroy it (leaving out collateral damage for the time being). Therefore, many resources go into the ability to locate and identify targets much more quickly. But the current response is from speed-of-sound platforms and weapons. That usually means many minutes from tasking to execution during which time the target can disappear. Wouldn't it be great to be able to engage instantly at the speed of light even if, in some cases,

that engagement was not lethal but delaying until precision munitions could be brought to bear?

Or consider the Long Range Strike Aircraft. Our technology (or related sensor technology) could acquire, track, and identify threats against the aircraft and then destroy those threats, creating an invisible and almost impenetrable shield around the aircraft. This same technology could also engage targets offensively. The ability to do that at the speed of light, with a large magazine, is not available today.

Closer at hand we can consider crowd control in a terrorist environment. By the end of this year we may see a prototype Active Denial System with RF emission providing point defense as well as area defense. Also potentially close at hand is the ability of DE weapons to defeat MANPADS, a capability that is ultimately important for civilian as well as military aircraft.

At the other end of the spectrum, consider global domination at the speed of light. Such a capability could arise from relay mirrors operating either in orbit or at high altitude, fed by lasers either from fixed points on the ground or from moving platforms. Such capabilities are a long way off, but initial relay mirror experiments will be conducted by the Air Force later this year.

I have been very parochial in describing only scenarios that I know something about. Many people probably have their own favorite list, but all of our lists may be wrong as judged by the Warfighter. However, this is the level (in much more detail) at which we need to enter the discussion in order to find out what is "right," or needed, or acceptable. Right now we desperately need the Warfighter and Operator to provide the conceptual framework for DE weapons. We need to get the technologists and system developers out of that business. We need an environment that provides close dialog and interface between the "wish I had" of the Warfighter and the "I can do this" of the technologist.

In summary, in Air Force lingo, we don't need more Orville and Wilbur Wrights (we are blessed with many of those). We desperately need a Billy Mitchell, who pioneered strategic bombardment and who wrote in 1925, "The advent of air power has made every country and the world smaller. We do not measure distances by units of miles, but by the unit of hours." With DE, we now need to change the unit to seconds. Most of you know that Billy Mitchell was court-martialed for his unauthorized advocacy of air power. But if you don't care to be court-martialed, a Jimmy Doolittle will be just fine.

The Author

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Graduate Scholarships in High Power Microwave (HPM) and High Energy Laser (HEL) Technologies

The Directed Energy Professional Society (DEPS) is seeking qualified scholarship candidates with interests in basic or applied directed energy (DE) research. Students must be full-time graduate students at a U.S. school for the term of the scholarship and are expected to be interested in pursuing or currently studying DE technology areas. The traditional academic disciplines involved in DE research include, but are not limited to, physics, electrical engineering, chemistry, chemical engineering, materials sciences, optical sciences, optical engineering, and aerospace engineering. Funding is provided by the High Energy Laser Joint Technology Office and by DEPS.

Applications are due in the spring of each year for the following academic year. Specific requirements and application procedures are available on the DEPS web site at www.deps.org or by calling DEPS at 505 998-4910.