

The UWB (Impulse) Radar Caper OR “Punishment of the Innocent”

Charles A. Fowler
Chairman, DARPA UWB Radar Panel
C.A. Fowler Associates
Sudbury, MA

PROLOGUE

In the early '70s Dave Israel sent me a copy of some insightful wag's description of a program.

The Nine Phases of a Program

1. Unbridled Enthusiasm
2. Guarded Optimism
3. Cool Objectivity
4. Quiet Confusion
5. Partial Disengagement
6. Utter Disenchantment
7. Search for the Guilty
8. Awards to the Non-Participants
9. Punishment of the Innocent

UWB [Ultra Wide Band] or Impulse Radar

Once upon a time a staff member from a large company seized upon the results of a beautiful optics experiment by a couple of very bright physicists and by extrapolating the results four orders of magnitude in frequency and an untold and indefinably large number of orders of magnitude in propagation media behavior concluded he could solve all kinds of microwave radar problems just by using very short pulses [“impulses”]. This questionable proposition augmented by other misapplications of scientific phenomena was pushed not with the technical community but through the political channels. [It is worth noting that his management, possibly blinded by the prospect of sole source business, didn't bother to seek an independent review of what were, to say the least, startling

and revolutionary notions.] Perhaps because he was with a large company, his congressman arranged to add \$25M to the Defense budget for work in the Impulse or UWB area. In these times \$25M is enough to stir up a lot of people and effort and stir up it did. All kinds of proposals and performance claims for impulse radar showed up including some questionable mathematics and the claim that a very short radar pulse would come and go so fast that a radar absorber wouldn't be unable to react and absorb.

The head of the DoD group blessed with this \$25M largess decided he needed to know more about the whole subject; so he asked the technical arm of the department, DARPA, to commission a study. The members selected by the DoD for the study panel consisted of 25 technical experts from government, academia, not-for-profits and industry. Ages ranged from “graybeards” to “bright youths.” Many of the members had achieved national and international recognition [Fellows, Young Engineer of the Year, etc.]; some were authors of note; and all were known for their objectivity and integrity. Although the panel members were mostly EEs, there were a few physicists including a well known and respected materials scientist. In addition the sponsor and DARPA added 20 observers from the various labs, agencies and involved support groups to attend the meetings and offer advice and furnish information. The panel was supported technically and administratively by the highly reputable BATTELLE Tactical Technology Center.

The panel listened to many proponents of and contributors to the field of Impulse Radar. It held in-depth technical discussions with all. It heard of interesting, creative work in the field by some of the principal contributors: Gerry Ross of ANRO, Roger Vickers of SRI, Larry Fullerton of Time Domain Systems, to mention some. It learned that commercially available Impulse Radars were doing terrain profiling, finding buried pipes and other objects, and doing other jobs where the

Author's Note: The views expressed in this paper are mine and are not necessarily those of other individuals or organizations.
Manuscript received September 9, 1992.
0885/8985/92 \$3.00 © 1992 IEEE

combination of good range resolution, relatively low frequency and a simple, inexpensive system was a clear winner for such short range applications. [The Associated Press recently carried a story about an attempt to determine if the explorer, Merriwether Lewis, was murdered or committed suicide. An Impulse Radar will be used to locate the body in the burial area.]

The panel also heard, at great length, a series of unusual claims: Counter-stealth capabilities; "covert" operation or "Low Probability of Interception" [LPI]; invulnerability to Anti-Radiation Missiles [anti-ARM]; lossless propagation; the inapplicability of Maxwell's equations and Fourier transforms to Impulse Radar analysis; etc.

The panel was urged repeatedly by one DoD official to go all out and develop a new Impulse Radar system on a crash basis. [It turned out that this same individual had urged and obtained priority for two other programs with totally unrealistic performance, cost and schedule goals; one of which was a total failure and the other eventually put back in exploratory development where it belonged.] The group was also urged to move with all speed by other DoD advocates because the Soviets were deploying impulse radars and thus the US was becoming increasingly at risk. Additional "unique attributes" were advocated. None of these claims were supported by analysis, theory or experiment. [I must note that this was the only time in my many years—and believe me there are a lot of them—where advocates, unable to give a reason or basis for a performance claim, answered: "that's why we need funding; so we can answer questions like that."] All these unusual claims were examined in detail by the panel and found to be lacking in substance and, in some cases, to violate basic laws of physics. The panel reviewed all the material it could obtain regarding Soviet Impulse Radar activities and could find nothing other than an interest in its use for Radar Cross Section [RCS] measurements, a promising application being pursued in this country also.

The panel published its report¹ which: pointed out the fallacies in the proposals of the extremists; noted the very good work of the real contributors; and made several recommendations including that the DoD fund "analyses of point designs comparing impulse and non-impulse approaches" for four short range radar military applications to determine if the "impulse" implementation had advantages [cost, weight, etc.] over more traditional approaches. It specifically recommended against spending money on measurements on stealth materials or vehicles because there was nothing unique about impulse radar in this application and, thus, the results were already known. The panel also concluded impulse radar does not offer a major new military capability nor does it present the threat of a serious technological surprise.

When the report was published the extremists didn't argue with the technical findings [which are well documented in the report] but made allegations against the panel and its members of bias, imbalance, conflict of interest, caving in to "the B-2 Mafia," incompetence, failure to consider Soviet work, etc.,

¹ Assessment of Ultra-Wideband (UWB) Technology; July 13, 1990. DTIC No. A DB146160. The Executive Summary of the report was published in the *IEEE Aerospace and Electronics Systems Magazine*, November, 1990, pp 45-49.

etc. The electronics reporter for a national aerospace magazine seized upon these items and wrote the whole subject up as a great conspiracy.

Several panel members and advisors and a number of "outsiders" expressed the view that the extremists, the congressman, and the reporter had done a disservice to the DoD, the technical community, the magazine's readers and this country.

EPILOGUE

"Punishment of the Innocent"

On December 13, 1990, the Inspector General of the Department of Defense announced an investigation of the panel and its members.

Yielding to congressional pressure the Air Force initiated a program to measure the performance of impulse radar against stealth materials and the F-117 aircraft.

In what would win my nomination for the most grossly inaccurate technical(?) article² of the year, a columnist castigates and belittles one of the panel members [a professional of well earned international stature and a record of long and continuing contributions to the radar field] because he wrote a paper on impulse radar that is accurate technically and thus does not mesh with the views of the most extreme advocates. This columnist also teaches a course on Impulse Radar. So for \$975 you can learn about a "powerful technique which can defeat low observable stealth techniques . . ."; "Some politics of stealth" and all the other disproven ideas on this subject.

AFTERMATH

After a long and thorough review, the Inspector General published his report: Memorandum for Director, Defense Research and Engineering, et al. Subject: Final Report on the Assessment of Balanced Technology Initiative for Ultra Wideband Technology; [Project No. IPT-5005]; dated 12/12/91. The review found no basis for any of the allegations and concluded the panel's report was credible and the panel balanced. This may well be the only investigation the IG ever conducted where it didn't find a thing to criticize.

The Air Force, after spending a couple million dollars on an extensive series of tests with an Impulse Radar, found that: radar absorbers work the same for both Impulse and conventional Radars; the F-117A's radar cross section was the same for both Impulse and conventional Radars; no other Impulse Radar characteristics exploitable against stealth technology were uncovered; and, thus, as the panel had concluded, Impulse Radar has no unique capability to counter low observable vehicles.

An honest-to-God technical meeting on this subject has been scheduled: International Conference on Ultra-Wideband Short-Pulse Electromagnetics, October 8-10, Polytechnic University, NY. For a mere \$200, one can listen for 2-½ days to the results of substantive technical work in the field.

² A&DS Spring 1991, pp 15-17

Dave Barton, reporting on a recent visit to the USSR Scientific Research Institute of Radio Device Engineering,³ wrote: "In regard to wideband signals, I mentioned the problem in some U.S. meetings of some people who do not rely on Maxwell's equations and the Fourier transform. They indicated that such people exist in their institute as well, but that they don't allow them in major meetings. They use impulse radar for target evaluation on RCS test ranges."

SOME BAD NEWS AND SOME GOOD NEWS

Although the individuals who conducted the IG investigation did a thorough and objective job and the report completely vindicated the panel's efforts and its members, the *BAD NEWS* is that the IG was brought into this straightforward technical issue in the first place. We've reached a sad point in this country

³ *IEEE Aerospace & Electronic Systems Magazine*, August 5, 1992.



Charles A. Fowler (A'46-M'55-SM'60-F'69) was born in Centralia, IL. He received his B.S. in engineering physics from the University of Illinois, Urbana in 1942.

From 1942 to 1945 he was a Staff Member at the M.I.T. Radiation Laboratory working on the development of the GCA radar landing system and an air traffic control system. From 1946 to 1966 he was at Airborne Instruments Laboratory where he was involved in developments in air traffic control and radar systems. From 1966 to 1970 he was the Deputy Director for Tactical Systems in the Office of the Secretary of Defense. From 1970 to 1976 he was Vice President and Manager, Equipment Development Laboratories, Equipment Division, Raytheon Company.

He joined the MITRE Corporation, Bedford, MA, in 1976 and retired as a Senior Vice President. He is currently the President of C. A. Fowler Associates, a consulting firm in Sudbury, MA. He was also the chairman of the Defense Science Board, a member and past chairman of the Defense Intelligence Agency Scientific Advisory Committee, and a former member of the Air Force Scientific Advisory Board. Mr. Fowler is a member of the National Academy of Engineering, a Fellow of the AAAS, an Associate Fellow of the AIAA, and a member of the AOC, Tau Beta Pi and Sigma Tau.



IEEE 1993 National Radar Conference

20-24 April 1993
Boston, Massachusetts

The IEEE 1993 National Radar Conference is being organized jointly by the IEEE Aerospace and Electronic Systems Society and the IEEE Boston Section.

The Technical Program Committee received 143 paper summaries by the 15 July cutoff date. The Chair of the committee is Fritz Steudel of Raytheon. The Deputy Chair is Dave Barton of ANRO Engineering.

The Papers Selection Subcommittee met on 1 August at The MITRE Corporation, Bedford, Massachusetts to make the final selection of papers for the conference. The reviewers included: Russ Logan, consultant; Eli Brookner, Raytheon; Bill Patton, General Electric; Charles Gager, MITRE; Gerry Trunk, Naval Research Lab; Bob O'Donnell, MIT Lincoln Lab; Ed Reedy, GTRI; Jay Schindler, Air Force Rome Lab; Tim Carey, Raytheon; Bob Trebits, Radar Systems Applications Lab; Adam Kozma, MITRE; Dave Barton, ANRO Engineering; Fritz Steudel, Raytheon; Carl Blake, consultant; Bob

Heimiller, ERIM; Dave Ethington, Hughes; Russ Lefevre, TSC; Les Novak, MIT Lincoln Lab; and Leon Poirier, Air Force Rome Lab.

when a few people whose ideas are rejected on technical grounds can shift the argument from the forum of technical debate to the netherworld of conspiracy and, with the help of an irresponsible press, bring in the "investigators." Furthermore we seem to have a group of semi-technical people who, as a colleague put it, seek to elevate to the status of scientific fact any opinion sufficiently strongly held.

There is, however, some *GOOD NEWS* for all you EE's and physicists: The Inspector General of the Department of Defense says it's OK to use Maxwell's equations and Fourier Analysis!!! When this great news reached Norm Augustine, he responded: "... I am pleased to hear we can still use Maxwell's equations—although I understand Newton's law is in jeopardy." This got me to thinking and guess what? Newton's Third Law—"For every action there is an equal and opposite reaction"—is no longer in effect in the USA! The Third Law must be revised. Newton's NEW Third Law: "For every action there is an opposing reaction *ten times* the magnitude of the original action." This paper is probably an example.

Many papers of high quality were submitted from not only the USA but from all over the world. A total of 36 papers were accepted for formal presentation at the conference sessions. A total of 27 papers were selected for presentation at the poster sessions. All 63 of these papers will be published in the conference record.

Session topics and corresponding session chairs for the conference are: Radar Systems, Russ Logan; Radar Antennas, Bill Patton; Radar Processing, Gerry Trunk; and Radar Phenomenology, Ed Reedy.

The conference preliminary program will be mailed in December 1992. If you would like to be placed on the conference mailing list, contact the Publicity Chair: William Donnellan, Westinghouse Electric Corporation, 275 Wyman Street, Waltham, MA 02154, USA; Phone: 617/890-9370. Fax: 617/890-1206.