Fraunhofer
INT

FRAUNHOFER INSTITUTE FOR TECHNOLOGICAL TREND ANALYSIS INT

ANNUAL REPORT 2013

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Images Title, top to bottom:

Future Security 2013, P. 65,
HPEM Measurements in Norway, P. 49;
3D-Printing (with kind permission from Leader Italia,
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Dear Readers,

"Panta rhei", the popular aphorism attributed to Heraclitus, means "everything flows". So already more than 2000 years ago, it was clear that change was the only constant – although we are the ones who claim, more than all foregone generations, to live in times of great change.

And to continue with Heraclitus, the river of time carried INT a little further last year, presenting us with new insights and challenges.

The reform process that the Federal Ministry of Defence and the Armed Forces prescribed for themselves entered a noticeable consolidation phase last year: the new structure of the Ministry is increasingly being felt outside; changes in the integrated planning process IPP and the revised CPM are already so well established that they form the basis of daily work.

In the past year, INT addressed this reform process in detail and repositioned itself in line with the changed landscape. Numerous discussions with the various departments and downstream areas of the Ministry have opened possibilities for intensifying and expanding cooperation with the Federal Ministry of Defence FmoD.

In 2013, the 8th future Security Research Conference was held; the rotation system again saw INT responsible for organizing and executing. With 200-plus participants from more than 17 countries, and 94 papers being selected from the 130 handed in, Future Society counts as one of the major international security research conferences, this time held again in Berlin. Thanks to perfect planning by the organization team, the event earned the Institute and the Fraunhofer Group for Defence and Security VVS much praise and recognition.

First steps were taken with regard to the Institute's local networking, setting up first contacts with the District Authority of Euskirchen and the Trade and Industry Chambers of Bonn-Rhein-Sieg and Aachen. Via Euskirchen's technology scout, INT is now regularly involved in economic development promotion in the district. In this context, INT will again be hosting the "7.45 business breakfast" in 2014. This event, at which business representatives from the area meet three or four times a year at different venues, gives people an opportunity to find out about the host organization and make new contacts over a breakfast. From past experience, we expect about 100 guests – and have high hopes that we shall be able to use our new seminar room.

An INT initiative for promoting science is entering a crucial phase: after first contacts with the local higher secondary schools last year, spring will for the first time see young scientists giving lessons on selected topics, with the opportunity to discuss with the pupils. The aim is not only to trigger enthusiasm for science studies before pupils reach senior grades and select specialist exam subjects, but also to provide an insight into a science career in a research institute. The first lesson, accompanied by the Press, will be on functional aspects of biology.

Another new activity field opened at INT in early 2014: after just over a year of preparation and mainly driven by the NEO Group in the Nuclear and Electromagnetic Effects Department, the new Fraunhofer Alliance Space was launched on February 10, with 13 institutions taking part initially. The Alliance administration was established at INT, and its Head of Institution was elected Alliance spokesman for three years. The first actions in this regard will be a Fraunhof day at the Space Agency of the German Centre for Aerospace in March, as well as participation at the International Aviation and Aerospace Exhibition (ILA 2014) in Berlin, with a joint booth for the Alliance Institutes.

Not least is also the progress in setting up the Chair at RWTH Aachen, the Rheinisch-Westfaelische Technical University at Aachen. The Methodology and Training Office, headed by Dr. Birgit Weimert and responsible at INT for the developing and improving future research methodology, is the bridge between Institute and Chair. The first courses were held in the winter semester 2013/2014, and the team was augmented when Stephanie Casteel joined the staff.

With baited breath we watched the strategy process last year, the second of its kind at INT since 2008. Numerous working groups developed new strategies for core competencies and work fields for the staff. A visible effect is the reorganization that became operative on January 01. Departments AP (Meta analyses and Planning Support) and TAV (Technology Analysis and Foresight) were dissolved and merged into the new Department TASP (Technology Analyses and Strategic Planning), with Dr. Joachim Schulze at its head. For the future, specially set up Business Units will be responsible for individual customer groups.

Under the firm management of Prof. Dr. Harald Wirtz, strategy coordinator and head of administration, all project targets were met and a test audit in February showed positive results. My thanks go to the INT Advisory Board, who as auditors contributed valuable proposals for further strategy development, so that we can look forward with optimism to the audit scheduled for July 2014.

Not least among the changes at the Institute is the continual progress in building work on the premises. There are good reasons to hope that we shall be able to take over the new library and seminar room in the middle of the year. Upgrades to the laboratory and canteen, the glass connection passage and the added storey on the office building should also be tackled as of July.

So, for the year just started, it seems as if the river of time will carry us along with unreduced speed, and we shall probably hit the odd rapids somewhere along the way. With its dedicated and highly-motivated team, INT will pass them safe and sound.

In this spirit, I wish you the inspiration to halt for a while on the banks of the river and to treat yourself to a good read with the Annual Report for 2013.

With all good wishes for the coming year,
Your

Prof. Dr. Dr. Michael Lauster

ANNUAL REPORT 2013

BUSINESS UNITS

FRAUNHOFER INT IN PROFILE

The Fraunhofer Institute for Technological Trend Analysis INT creates and continuously updates a comprehensive overview of the general research and technology landscape and of the entire spectrum of national and international technological developments. In addition to this general overview, we generate our own specialized analyses and forecasts in selected technological areas.

For more than 35 years, the institute has advised the German Federal Ministry of Defense on questions of technology and on how to plan and realize new research and technology projects. In recent years, there has been an increase in the volume of research carried out for other public institutions involved in security precautions and long-term changes in society. In addition to this, the INT performs its own experimental and theoretical research on the effects of ionizing and electromagnetic radiation on electronic components and systems.

The Institute is equipped with state-of-the-art measurement technology. The major laboratory and large-scale devices are radiation sources and electromagnetic simulation facilities which cannot be found in this combination in any other civilian institution in Germany. Our main clients include authorities and organizations concerned with security affairs and precautions, as well as aerospace companies and their suppliers.

THE INSTITUTE'S SERVICES ARE STRUCTURED IN FIVE BUSINESS UNITS:

BUSINESS UNIT

TRENDS IN RESEARCH AND TECHNOLOGY

BUSINESS UNIT

PLANNING, PROGRAMS AND STRUCTURES IN RESEARCH AND TECHNOLOGY

BUSINESS UNIT

NUCLEAR SECURITY POLICY AND DETECTION TECHNIQUES

BUSINESS UNIT

ELECTROMAGNETIC EFFECTS AND THREATS

BUSINESS UNIT

NUCLEAR EFFECTS IN ELECTRONICS AND OPTICS

ORGANIGRAM

DIRECTOR'S OFFICE

Director
Prof. Dr. Dr. Michael Lauster
Phone +49 2251 18-117/-217
michael.lauster@int.fraunhofer.de

Vice-Director
Dr. Joachim Schulze
Phone +49 2251 18-303
joachim.schulze@int.fraunhofer.de

Assistant to Director
Inge Pastuszka
Phone +49 2251 18-217
inge.pastuszka@int.fraunhofer.de

DEPARTMENT TECHNOLOGICAL ANALYSES AND STRATEGIC PLANNING (TASP)

Head
Dr. Joachim Schulze
Phone +49 2251 18-303
joachim.schulze@int.fraunhofer.de

Deputy
Dipl.-Volksw. Hans-Martin Pastuszka
Phone +49 2251 18-298
hans-martin.pastuszka@int.fraunhofer.de

Secretariat
Klara Hardtke
Phone +49 2251 18-223
ap-sekretariat@int.fraunhofer.de

DEPARTMENT BUSINESS ADMINISTRATION AND CENTRAL SERVICES (BZD)

Head
Prof. Dr. Harald Wirtz
Phone +49 2251 18-237
harald.wirtz@int.fraunhofer.de

Deputy
Waltraud Rasmussen
Phone +49 2251 18-236
waltraud.rasmussen@int.fraunhofer.de

Dipl.-Math. Wilfried Gericke
Phone +49 2251 18-259
wilfried.gericke@int.fraunhofer.de

Secretariat
Sabrina Langemann
Phone +49 2251 18-226
sabrina.langemann@int.fraunhofer.de

Marketing and PR
Dipl.-Journ. Thomas Loosen
Phone +49 2251 18-308
thomas.loosen@int.fraunhofer.de

Library and Specialized Information Services
Siegrid Hecht-Veenhuis
Phone +49 2251 18-233
siegrid.hecht-veenhuis@int.fraunhofer.de

DEPARTMENT NUCLEAR AND ELECTROMAGNETIC EFFECTS (NE)

Head
Dr. Wolfgang Rosenstock
Phone +49 2251 18-249
wolfgang.rosenstock@int.fraunhofer.de

Deputy
Dr. Michael Suhrke
Phone +49 2251 18-302
michael.suhrke@int.fraunhofer.de

Secretariat
Giesela Fuss
Phone +49 2251 18-218
giesela.fuss@int.fraunhofer.de

STRATEGY PROCESS

Prof. Dr. Harald Wirtz, Thomas Loosen, M. Sc.

Within the Fraunhofer-Gesellschaft, individual institutions are encouraged to review their own strategic direction at regular intervals. What should be examined is whether an institute's strategic goals need rethinking and whether the institute's current alignment is well positioned to achieve these goals. To that end, each Fraunhofer Institute conducts a strategy survey about every 5 years. Fraunhofer INT completed its last survey in 2008, and when the new Director took over in 2012, the beginning of 2013 was an opportune time to launch the new strategy process.

To implement the strategy process, a strategy group was formed which consisted of executives and experienced staff members from different departments. The process was coordinated by Prof. Dr. Harald Wirtz, Commercial Director, and Thomas Loosen, the Head of Marketing and PR. In workshops on different levels, the entire Institute was closely involved in analyzing and developing the different sub-strategies. To secure an external perspective, Dr. Gudrun Quandel from the Fraunhofer Marketing Network was taken on board as a consultant at the beginning of the strategy process. In 2014, external auditors from politics and industry will be auditing the new strategy in line with Fraunhofer-Gesellschaft policy.

At the beginning of the process, a detailed analysis of the current situation identified and analyzed the problems in the Institute's setup thus far. The Institute's existing business units, core competencies and organizational structure were studied accordingly. Especially in the case of business units 1 „Trends and Developments in Research and Technology" and 2 „Planning, Programs and Structures in Research and Technology", examination focused on a more comprehensible setup for the customer and on how recognized synergy potential could be better exploited.

As a strategy process consequence, a complete reorganization of the business units, core competencies and organizational structure was adopted. Of the previous five, two new core competencies were formed, namely „Technological Analyses and Strategic Planning" and „Nuclear and Electromagnetic Effects." These two core competencies reflect the two in-house research orientations: scientific support for the strategic decision-maker in research and technology management, and specialist physical research on radiation effects.

The business units in turn arise from these two core competencies. In the case of nuclear and electromagnetic effects, while distinguishing between the three business units „Nuclear Security Policy and Detection Techniques (NSD)", „Electromagnetic Effects (EME)" and „Nuclear Effects in Electronics and Optics (NEO)" on the basis of clear scientific and technical demarcation criteria had stood the test, a new order had to be found in the field of strategic planning support. From the aspect of dimensions for defining the business units, it became clear that it made sense to differentiate by above all giving regard to the various customer groups. Accordingly, all business units will treat the entire range of relevant products, topics and methods, each tailored to the specific requirements of the customer groups concerned.

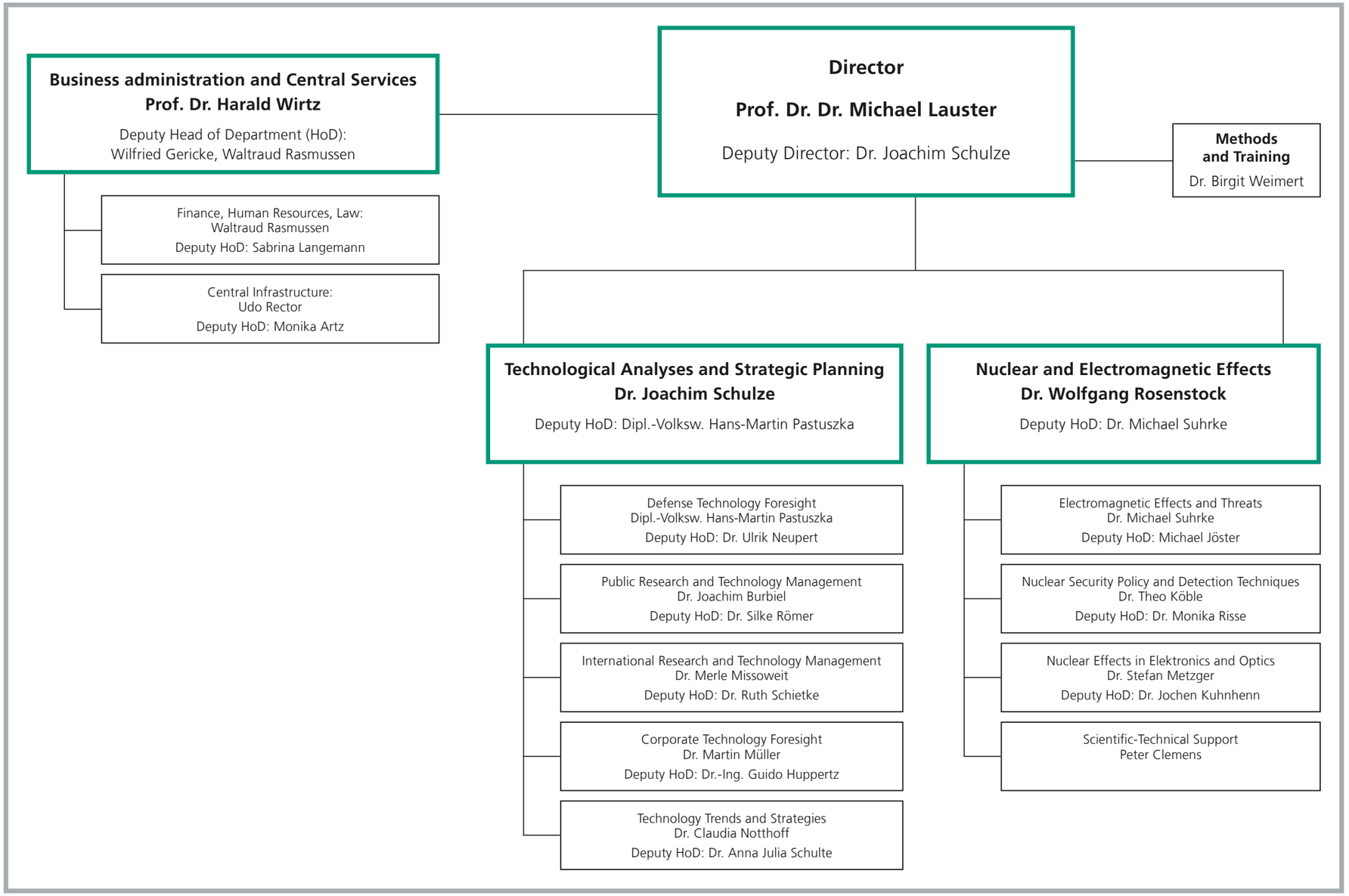
In line with this basic idea, the Business Unit "Wehrtechnische Zukunftsanalyse WZA" (Defense Technology Foresight) will align its research and consultancy work entirely to the needs of its most important client, the Federal Ministry of Defense BMVg. Correspondingly, the Business Units "Öffentliches Forschungs- und Technologiemanagement ÖFT" (Public Research and Technology Management) and "Internationales Forschungs- und Technologiemanagement IFT" (International Research and Technology Management) will cater for other national or international public sector clients. Finally, the Business Unit "Corporate Technology Foresight CTF" will focus exclusively on clients from industry. Looking at this alignment from outside, it becomes plain that client orientation is the operative maxim.

Following the Chandler principle „structure follows strategy", the organizational structure was adapted to the new order. Operative as of January 1, 2014, the structure has only two scientific departments, each supporting one of the two core

THE NEW ORGANIZATIONAL STRUCTURE

competencies, named respectively "Technological Analyses and Strategic Planning TASP" and "Nuclear and Electromagnetic Effects NE". Each business unit forms an organizational group within the department concerned. In addition, the department TASP also has the group "Technologie- und Planungsmonitoring TPM" (Technology Trends and Strategies) which – as a strategic project at first – is to reorganize the Institute's monitoring of technological developments and research programs. In the department NE, the group "Scientific-Technical Infrastructure WTI" continues its task of operating the laboratories and scientific facilities used by the entire department. To this end, a Staff Office for Methodology and Training was set up at Institute management level. This should facilitate further development in the range of methods for technology analysis at the Institute. The Staff Office also has the task of coordinating activities for the Chair "Technology Analyses and Forecasting in Security Research".

Through this reorganization, the former three-way structure of business unit, core competencies and organizational units has been dissolved and reformed, with tasks distinctly allocated. In practical terms, this means that the departments TAV and AP have been wound up and a new TASP department has been formed in their place.



FRAUNHOFER INT FACTS AND FIGURES

Staff

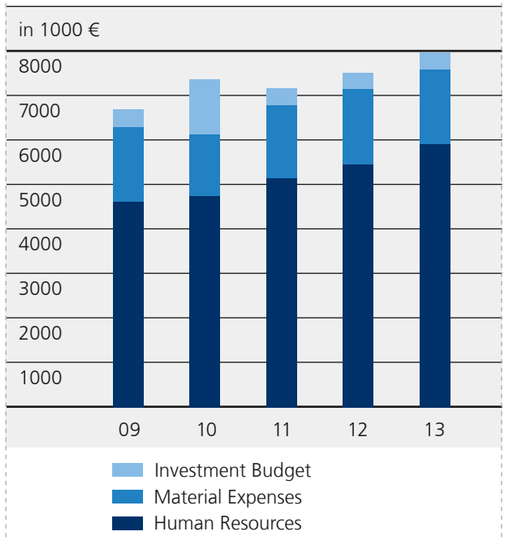
In 2013, the Institute was able to further increase its staff capacity. The Institute now has 55 scientists, covering a wide range of natural and engineering sciences, also economics, social and human sciences. The researchers are supported by graduate engineers, technologists and administrative specialists. In addition, INT has a network of freelance scientists who are regularly involved in the Institute's work.

Budget

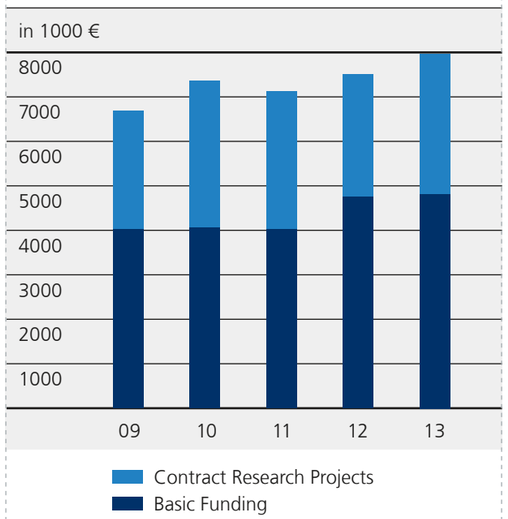
The Fraunhofer Gesellschaft distinguishes between operating and investment budgets. The operating budget covers all staffing and administrative expenditure, the investment budget concerns the procurement of capital goods such as scientific apparatus and technical equipment. The operating budget amounted to € 7.5 million. Together with an investment budget of € 372,000 the Institutes overall budget totals at almost € 8 million. As well as the amounts shown for investment in scientific infrastructure there is also the expenditure for work on the new library and a seminar building. This is funded by the Federal Ministry of Defence BMVg and is not shown in the Institute's budget.

Along with basic funding from BMVg, which enables the implementation of a coordinated research program, the Institute is also processing a number of contract research projects. As well as the public sector, project clients range from small and medium sized companies to DAX-30 groups and associations and international organizations. Income from EU projects was considerably higher than in previous years. In the public sector, our largest client is the Federal Ministry of Defence, for which we have been an in-depth consultant in research and technology planning for 40 years.

Budget from 2009 – 2013



Financial Development from 2009 – 2013



Human Resources

	2011		2012		2013	
	Manned Positions	People	Manned Positions	People	Manned Positions	People
Scientists	46.3	49	46.6	50	51.9	55
Graduates	16.7	18	18.5	19	18.5	19
Technicians / Others	13	14	17.4	19	16.9	20
Assistants / Trainees	5.5	21	5.5	22	5.4	17
Total	**81.5**	**102**	**88**	**110**	**92.7**	**111**

Budget

in 1000 €	2009	2010	2011	2012	2013
Expenses					
Operating Budget	6297.3	6111.0	6787.0	7146.0	7607.9
of which Human Resources	4606.5	4718.0	5150.0	5461.0	5915.7
of which Material Expenses	1690.8	1393.0	1637.0	1685.0	1692.2
Investment Budget	391.1	1230.0	362.0	367.0	372.0
Total	**6688.4**	**7341.0**	**7149.0**	**7513.0**	**7979.9**
Funding					
Basic Funding	4071.0	4047.0	4032.0	4772.0	4820.9
Contract Research Projects	2646.4	3295.0	3117.0	2741.0	3159.0

ADVISORY BOARD

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The Institute is advised by an Advisory Board which is composed of people from industry, science, politics and administration.

Chairman:

Prof. Dr. Horst Geschka; Geschka & Partner

Members:

- Herr Dr. Walter Bernard; Diehl BGT Defence GmbH & Co. KG
- Herr Klaus Burmeister; Z_punkt GmbH
- Herr Dr.-Ing. Karsten Deiseroth; IABG GmbH
- Herr Prof. Dr. Horst Geschka; Geschka & Partner Unternehmensberatung Innovarium
- Herr Dr. Wolf Junker; Bundesministerium für Bildung und Forschung (BMBF)
- Herr DirWTD Rainer Krug; Wehrtechnische Dienststelle für Informationstechnologie und Elektronik (WTD 81)
- Herr Dir Prof. Dr. Winfried Schuhn; Wehrwissenschaftliches Institut für Schutztechnologien – ABC-Schutz (WIS)
- Herr MinR Norbert Michael Weber; Bundesministerium der Verteidigung (BMVg)
- Herrn Dr. Hans-Ulrich Wiese
- Herrn Dr. Thomas Weise; Rheinmetall Aktiengesellschaft
- Herrn Prof. Dr. Dr. Axel Zweck; VDI Technologiezentrum

1 *Adivsory Board meeting on June 13 2013.*
Representative of the Executive Board:
Dr. Hans-Otto Feldhütter

THE FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 67 institutes and research units. The majority of the more than 23,000 staff are qualified scientists and engineers, who work with an annual research budget of 2 billion euros. Of this sum, more than 1.7 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787 – 1826), the illustrious Munich researcher, inventor and entrepreneur.

FRAUNHOFER VVS – GROUP FOR DEFENSE AND SECURITY

The VVS continues being the national authority in the field of security and defense research. The German Federal Ministry of Defence (BMVg) honors the contribution of the national security and defense research helping the German Armed Forces to fulfill their diverse and complex tasks.

Inclusion of security and defense research in the scientific identity of Fraunhofer-Gesellschaft

Since its founding, the Fraunhofer-Gesellschaft has been obligated to the Federal Ministry of Education and Research (BMBF) as well as to the Federal Ministry of Defence (BMVg). Due to its vast portfolio, Fraunhofer covers the largest part of the institutional research conducted for the BMVg.

Welfare and growth of our industrial societies depend on globally highly linked critical infrastructures, the failure or destruction of which have the potential to carry incalculable economic and social consequences. Furthermore, fading borders between interior and exterior, between public and private security confront our state institutions, which are responsible for security measures, with so far unknown challenges when facing modern phenomena such as internationally operating terrorism, transnationally organized crime, as well as local natural catastrophes and major accidents with possibly global impacts. In order to early detect and possibly prevent the vast number of possible hazards from occurring and to minimize the consequences, the VVS is developing thorough technological security solutions and the accompanying methodological, procedural, and tactical concepts.

Member institutes are the Fraunhofer institutes for

- High-Speed Dynamics, Ernst-Mach-Institut, EMI
- Applied Solid State Physics IAF
- Chemical Technology ICT
- Technological Trend Analysis INT
- High Frequency Physics and Radar Techniques FHR
- Communication, Information Processing and Ergonomics FKIE
- Optronics, System Technologies and Image Exploitation IOSB
- Systems and Innovation Research ISI (guest institute)
- Integrated Circuits IIS (guest institute)
- Telecommunications, Heinrich-Hertz-Institut, HHI (guest institute)

Chairman of the Group

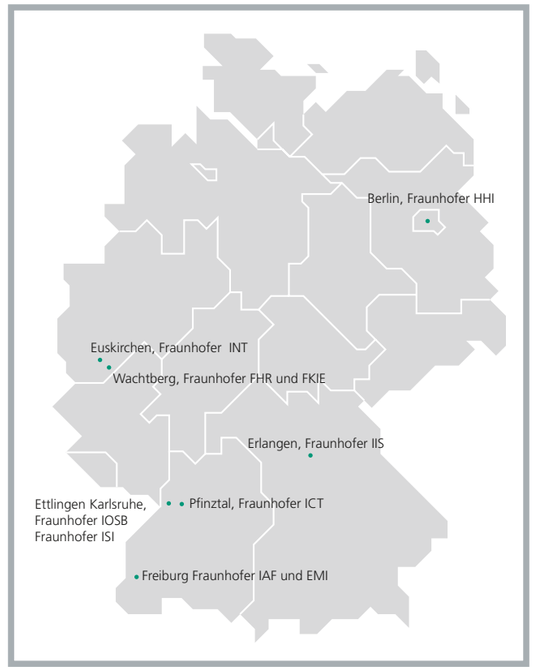
Prof. Dr. Klaus Thoma
Fraunhofer EMI

Deputy Chairman of the Group

Prof. Dr.-Ing. Jürgen Beyerer
Fraunhofer IOSB

Central Office

Daniel Hiller
Fraunhofer EMI
daniel.hiller@emi.fraunhofer.de



BUSINESS UNIT “TRENDS AND DEVELOPMENTS IN RESEARCH AND TECHNOLOGY”

Dr. Matthias Grüne

This Business Unit of Fraunhofer INT provides the customer with the products and results of our technology-oriented futures research. Planners and decision-makers are thus provided with a future-oriented guidance in an ever more complex environment. Work in the Unit focuses primarily on the substantive discussion of research and technology issues, which ensures the ability to in-depth discussion with researchers on the one hand and clients (technology planners) on the other. The services are provided by the Technology Analysis and Foresight Department (TAV). This consists of scientists and engineers with comprehensive specialist expertise in all fields of science and technology, which is in turn augmented by all-round expertise in methodology and foresight processes. By using our own specialists’ insights when analyzing technological subjects – something rare in futures research – we achieve high-grade forecasting for both the whole picture and the analysis of single developments. Our internal peer-review process serves to ensure this.

For our main client, the German Federal Ministry of Defense, the year 2013 was marked by the “Reorientation of the Bundeswehr”, which led to intensive contacts with newly structured Ministry and Bundeswehr departments. The Defense Technologies Forecast (“Wehrtechnische Vorausschau WTV”), which Fraunhofer INT produces to support Bundeswehr planning and which has been redesigned in the past years, often served as a door opener and as a starting point for further discussion. Furthermore, the results of our study on a “post-fossil Bundeswehr”, completed in 2013, could be introduced in various ways into Bundeswehr-internal discussion processes.

Work in the Business Unit can be described in the following four fields:

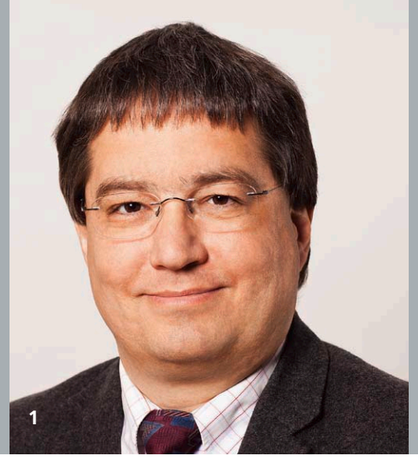
Technology Foresight: Overview of Future-Relevant Themes

Our Technology Foresight serves to create the most comprehensive overview of future-relevant scientific and technological progress and its application potential. This calls for the continuous assessment of all relevant sources (scientific papers, conferences, etc.). The most important result of this work is the identification of “core topics” – i. e. highly dynamic research and high-tech development topics that show great application potential. These topics provide the starting point for further investigation. Results from our Technology Foresight are usually published, e.g. in the form of the monthly Fraunhofer INT column on New Technologies in the professional journal “Europäische Sicherheit & Technik” (European Security & Technology).

Advancement in Methodological Tools

The critical examination of one’s own methodological basis and its further development is a self-evident part of the work of a scientific institute. In 2013, the spotlight was again on our own bibliometric processes and tools, which were formed into a practical toolbox that constantly undergoes improvement. Meanwhile, bibliometric analyses are a standard part of most of our technology-foresight projects. A number of conference contributions were again published on the scientific basics of this “trend-archaeology” approach of using bibliometrics for technology foresight.

In a book chapter within the Springer series “Zukunft und Forschung” (future and research) by the head of the Business Unit, special aspects and methodological approaches of defense-related technology foresight are characterized. In the



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course of an EU FP7 project, "ETCETERA", the success of the foresight methodologies of three institutions was evaluated by a third party. Fraunhofer INT's approach clearly came out on top – a welcome reassurance of our work.

In the context of our study on a "post-fossil Bundeswehr" and of another study on behalf of the Bundeswehr Planning Office, new interactive workshop designs were developed: professionally facilitated focus-group workshops and the "War Café". These workshop designs have proven very successful, as has the "Technology Assessment Gaming", co-developed by Fraunhofer INT. All these approaches will be developed further.

In-depth Technology Analyses

In our Technology Analyses, several technological questions undergo long-term, in-depth examination with regard to their future potential and/or defense relevance. The focus is currently on materials, energy technologies, unmanned systems / robotics, information and communications technology, and biological technologies / life science. Part of the results is made available to the Federal Ministry of Defense and its agencies in the publication series "Analysen und Expertisen zur Technologievorausschau" (analyses and expert reports in technology foresight), relaunched in 2011 as the successor to a series running since 1991.

In particular, the cross-material-class and in-depth expertise in the field of materials represents a unique selling proposition of the Business Unit. This competence is regularly documented in our own series "Werkstofftrends" (materials trends) in the specialist journal "Werkstoffe in der Fertigung" (materials in the production process), as well as in presentations at materials conferences. A large proportion of our industrial projects were acquired in this area of competence.

Defense Technology Foresight – the Technology Radar for the German Federal Ministry of Defense

In our Defense Technology Foresight activities, we assess and describe the (especially long-term) relevance of scientific and technological progress for the Bundeswehr in the light of foreseeable threats and the capabilities required. The main result is the periodical "Wehrtechnische Vorausschau" (Defense Technologies Forecast). The Business Unit's participation in various committees for international cooperation on defense-related research and technology serves the constant improvement and updating of our defense technology assessment criteria. Results from Defense Technology Foresight are also taken into account in the technology evaluation process of the Round Table of German-MoD-funded research institutions.

For the years 2011 – 2013, Fraunhofer INT was given the task of producing a study on a "post-fossil Bundeswehr", for which this Business Unit acted as coordinator. Our in-depth expertise in energy technologies and the outcomes of the Defense Technologies Forecast served as a valuable basis for designing the discussion process based on focus-group workshops and for the subsequent completion and editing of the project results.

The Defense Technologies Forecast was also the reason why the Unit was tasked with technology analyses for "Teknisk Prognos", an organ of the Swedish Defence Materiel Administration. Overall, these orders meant that for this Business Unit the market segment of defense foresight has the largest share of contract research.

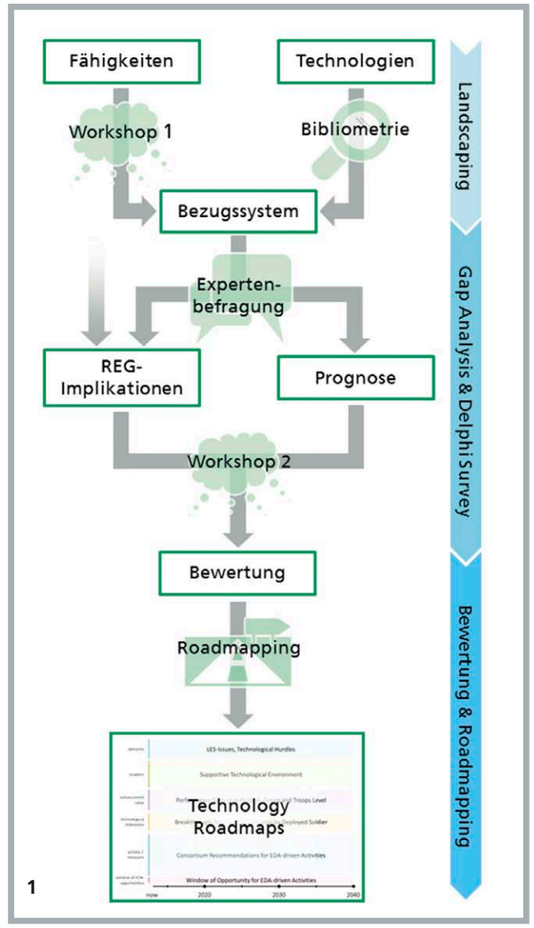
1 *Dr. Matthias Grüne*

HUMAN PERFORMANCE ENHANCEMENT

Dr. Carsten M. Heuer, Dipl.-Ing. Stefan Reschke

The desire to boost one's own performance beyond the norm is inherent to human nature. From the wagon wheel to airplanes, from the jungle drum to smartphones: without technologies that give us capabilities beyond our physical and intellectual limits, modern society could not exist. Particularly (but not exclusively) in military scenarios, human performance is pivotal. The range of Human Performance Enhancement (HuPE) made possible through current and future technologies, as well as the legal, ethical and societal issues raised by HuPE were the subject matters of a study commissioned by the European Defence Agency (EDA). The study was conducted by the Fraunhofer INT in 2013. The study was a co-operative effort with several other European institutions and had been commissioned by the European Defence Agency (EDA).

"HuPE comprises all technical means that can be used to boost the physical and psychic capabilities of humans beyond the dimension of normal variation." Based on this definition, a two-dimensional reference system juxtaposing technologies (Enhancement Technologies) and capabilities (Human Capabilities) was established in the first project phase. Technologies that can principally be used to enhance performance were determined through exhaustive bibliometric analyses (Figure 1). As a result, the relevant individual technologies could be assigned to 15 technological fields falling under the general categories "Biotic Modifications" (e. g. pharmacological factors, genetic modifications) and "Abiotic Modifications" (e. g. implants, body or brain-computer interfaces). Parallel to this technology landscaping process, the capabilities landscape was developed through the active discourse with military experts. Based on generic scenarios, it was possible to identify 15 characteristics considered critical for future missions – including situational awareness, memory skills, physical endurance, physical and intellectual resistance, motivation and social intelligence, concluding the first phase of the project.



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1 *Schematic Workflow regarding „Human Performance Enhancement" within the EDA-Project*

The second project phase aimed to elucidate which technology fields harbour the highest potential to enhance the capabilities of critical importance in the future. A systematic survey of European technology experts helped the researchers to better understand the interactions between technologies and capabilities more thoroughly, to assess the attainable performance enhance-

ments more precisely and to get more concise estimates of the technological advancements to be anticipated. Along with a concept document developed within the consortium on the legal, ethical and societal implications of HuPE is another notable result of this survey. The survey provided the basic content for an interactive discussion on the possible military benefits of these technologies during a second workshop with the EDA representatives of the member states.

Based on a comprehensive analysis of the surveys and discussions conducted during the second project phase, it was possible to identify the enhancement technologies that offered the highest potential usefulness in the final project phase. Subsequently, roadmaps were developed for these technology fields (pharmacological enhancement, preventative medication / inoculations, non-invasive brain-machine and body-machine interfaces) as well as for three other potentially seminal HuPE approaches. Based on a time horizon of 2015 – 2040, the roadmaps summarise the projected development advances and factors on multiple levels (milestones, enablers and obstacles). They also sketch out the potential enhancement effects and give the EDA action recommendations for given time periods, which could impact the military usefulness of the technology (e. g. research initiatives, etc.).

As far as security and defence policies are concerned, it is of particular importance to anticipate future technologies early-on. For the field of HuPE, the study was able to demonstrate that many of tomorrow's technologies will evolve from the therapeutically motivated research endeavours of today. Among the examples are high tech prostheses and exoskeletons, which aim to reinstate motor functions through interpretations of nerve signals, or pharmacological substances that are supposed to counteract degenerative phenomena caused by diseases. In particular in the latter technology field, a (performance) societal willingness to embrace performance enhancement is evident already today in the so-called off label usage of therapeutic psycho-pharmaceutical products (e.g. Methylphenidate, Modafinil) to improve mental and cognitive skills. At the same time, the consolidation of transhumanistic groups that view technological progress as a chance to leave the limitations of human nature behind them is also underway. Considering these factors, the EDA-commissioned study enables the member states helps assessing the risks and opportunities of HuPE and to initiate a well-informed opinion building process based on a detailed technology description and outlook.

3D PRINTING

Dr. Carsten M. Heuer, Dr. Heike Brandt

Technology enthusiasts and futurologists had one thing in common in 2013 – 3D printing was the topic of the year. Almost every day, the websites of popular technology magazines such as Wired or Gizmag were abuzz with news on the latest advancements and breakthroughs in the discipline of 3D printing and their potential impact on all of our lives. But are we indeed on the verge of a "democratisation of production"? What are the opportunities and risks inherent in this "new" technology? In 2013, these and other questions were of course also the topic of numerous projects in the INT's Department for Technological Analyses and Strategic Planning.

Amid all the hype it is easy to forget that 3D printing is definitely not a new technology. Stereo lithography, the first process to facilitate the direct transfer of computer-generated models into actual objects, was patented as early as 1986. Nothing much has changed since then: 3D printers turn data into things. The basis is always a digital model, for instance a CAD design or the 3D scan of an object. Using special software, the model is subsequently sectioned into a series of slices along an axis. Ultimately, the printer realises these slices layer-by-layer, depositing and / or fusing suitable materials to build a three-dimensional corpus, step-by-step. Compared to conventional production processes (milling, casting, forging, etc.), this additive manufacturing process makes it possible to save a significant amount of resources. It also allows for the production of highly complex single-piece shapes. It would appear that this virtually eliminates all restrictions from the creative design of products: "If you can draw it, you can make it."

One of the early applications of 3D printing was the fast implementation and depiction of design drafts, so-called rapid prototyping. As a result of the development of new 3D printing processes and the maturation of the technical systems, the production of increasingly sophisticated components became possible in the following years. The spectrum of applications for industrial 3D printers thus expanded to the production of end products (rapid manufacturing). Since 2005, a highly active "Maker Community" and its open source projects, paired with the expiration of basic patents, began to drive the private use of 3D printers. This development also ushered in a rise in public interest in the technology. Nowadays, home users can buy entire desktop systems from commercial manufacturers for prices starting at around € 1000. Online sharing sites like thingiverse give them access to 100,000 design templates that are in the public domain.

The sharing and exchanging of digital object templates does of course come with similar inherent risks as the virtually uncontrollable distribution of digital audio and video formats. A wide spectrum of intellectual property rights infringements could be on the horizon – from simple replications to detailed copies to the pirating of products. Digital rights management systems and authenticity codes could be feasible solutions to prevent the sale of illegitimate and low quality forgeries by plagiarists. Given the extreme sensitivity of this issue, the public focus is in particular also on the printing of security-relevant objects (e. g. keys, weapons). It is already possible to readily download digital templates for the at-home manufacturing of functional firearms from the Internet. Given that personal printers almost exclusively use thermoplastic raw materials, though, such instructions – in a best case scenario – can currently only be used to make single-use products that are far inferior to their traditionally manufactured counterparts in terms of stability, precision and safety. Nonetheless, it remains unclear which methods can be used to control the proliferation of such objects or file templates in the future.

On the positive side, 3D printing does pave the way for new and exciting options in a wide variety of applications. Especially the individualisation and customisation of products is an interdisciplinary scope of application, which reaps benefits from the relatively simple methods required to modify digital templates. In the medical field, 3D printing is already being used to manufacture patient specific implants and prostheses. However, it is also possible to print custom garments, fashion accessories, sporting devices and musical instruments. The industry utilises 3D printing increasingly for the production of highly specialised

components and in small series production. Aircraft manufacturer Boeing, for instance, is currently making more than 200 different components using additive production processes and the trend is growing. Moreover, in parallel to established processes, new materials, methods and applications for 3D printing are being researched continually. A metal alloy that is liquid at room temperature and a thermoplastic composite that has conductive capabilities are just two of the innovative materials scientists introduced in 2013. Lauded for its revolutionary medical potential, the emerging field of bioprinting centres on the use of 3D printing methods to consolidate functional tissues and entire organs from living cells. Another interesting application is contour crafting, which could make it possible to erect architectural structures using computer-controlled crane-like robots. This would allow it to construct buildings faster, while using less material and embedding integral components directly. In this context, NASA is looking into the possibility of erecting extra-terrestrial base stations through the melding of locally available sediments.

As a potential trigger and driver of a "new industrial revolution," 3D printing is actually a disruptive technology. The proliferation of additive production processes may lead to immense changes in the globalised economy, if globe-spanning supply chains become obsolete because the production has been outsourced to the consumer. The exchange and realisation of digital object files may create novel business models that put existing concepts to the test. However, it appears to be questionable whether 3D printing will actually be able to meet the high expectations fired up by the current hype. In economic terms it is e. g. not likely that additive production processes will put traditional manufacturing methods in large series production environments out of business in the short to medium term. Moreover, because the production is being outsourced to the consumer, the quality of the additively manufactured products (accurate dimensioning, visual appearance, stability, etc.) and the user friendliness of the systems in use (file formats, operation, etc.) can be identified as critical factors for the future role of 3D printing.

FUTURE AIRCRAFT PROPULSION

Dipl.-Phys. Jürgen Kohlhoff

Along with the international environmental legislation aiming at combating climate change, the increasing costs of fossil fuels will also lead to significant changes in the future of aircraft engineering. The foreseeable technical measures in this context range from the usage of alternative fuels and the boosting of the effectiveness of conventional engines to the realisation of electrical engines also in the field of air travel. The industry aims to achieve additional optimisations e.g. through new fuselage and wing concepts as well as innovative air traffic management systems.

The aeronautical industry has already made relatively large strides when it comes to the usage of **alternative fuels**. The industry bets on synthetic kerosene, which can be added to fossil kerosene as a so-called drop-in fuel and that does not require any significant modifications as far as the aircraft, engine or infrastructure are concerned. Synthetic kerosene can be manufactured from coal or natural gas (Coal-to-Liquid, CtL; Gas-to-Liquid, GtL); however, these processes do not generate any or only minimal climate protection effects. These, on the other hand, would be a given if the kerosene were made from general biomass (Biomass-to-Liquid, BtL) or specially made hydrogenated vegetable oils (Hydrogenated Vegetable Oil, HVO). Official international approvals as aircraft fuels have already been issued for HVO and BtL. Up to a maximum of 50 % of them may be added to conventional kerosene.

The primary problem inherent in the use of bio fuels in air travel is the still insufficient current and uncertain long term availability of these resources. Potential alternatives under consideration are natural gas that has been liquefied as a result of refrigeration (Liquefied Natural Gas, LNG) or hydrogen (Liquefied Hydrogen, LH_2). However, neither are drop-in solutions. Their use would re-quire modifications to aircrafts that range from minimal to major (e.g. larger tanks) and in the service infrastructure.

In parallel to the usage of alternative fuels, the industry is making intense efforts to boost the propulsive efficiency of conventional engines. These solutions bet on advanced developments of the established ducted-fan turbine engines (turbofan), in which the interior central stream, which participates in the actual thermodynamic cycle of the gas turbine, is "encased" by an exterior bypass flow driven by a fan. A characteristic feature of the effectiveness of a turbofan is the bypass flow ratio, i. e. the ratio of the air volume of the bypass flow to the air volume, which streams through the gas turbine. The increase of these bypass flow ratios is the objective of the development.

The first step that will boost the bypass flow ratio is achieved by the so-called **geared turbofans**, which are now also in the process of being launched into the market in the large passenger aircraft segment and are e. g. already being offered by Airbus under the name New Engine Option (NEO). In these, a reduction gear ensures that the RPM speed of the fan is reduced while that of the turbine can be increased to ensure that both components are always working in their optimum RPM ranges. Geared turbofans yield potential fuel savings of about 15 % (compared to "Year 2000 engines") and they achieve this with only insignificantly modified engine dimensions.

The development of so-called **open-rotor engines** will not be complete until 2020. They work with two counter-directional rotors without covers (making them fully visible from the exterior). They will yield potential fuel savings of about 20 % (compared to "Year 2000 engines"). Contrary to the slower turbo prop engines, whose propulsive thrust is generated almost exclusively by the propellers driven by gas turbines (e. g. Airbus A400M), the thrust of the actual gas turbine still makes a significant contribution to the propulsive thrust in the open-rotor concept.

However, open-rotor engines do generate a lot more noise than geared turbofans. To avert this, the industry is striving to develop encased versions of these engines. They could be ready for series production by 2025. A German development program in this context is the CRISP project (**counter-rotating integrated shrouded prop fan**), which has been relaunched now

that fundamental technical progress has been made. In these engines, two rotors run in opposite directions under a shroud (casing piping), specifically at the front or the back of the engine.

Attempts to increase the thermodynamic effectiveness of the gas turbines as such are being pur-sued in parallel to the boosting of the propulsive thrust's effectiveness. Manipulations of the aggregates' temperature management are supposed to yield improvements. In a first step, the integration of an **intercooled core** and ultimately of an additional exhaust gas heat exchanger (**intercooled recuperated core**) are being considered. A geared turbofan engine with an intercooled recuperated core could be ready for take-off after 2035 and has the potential to use 30 % less fuel than a "Year 2000 engine." It will also be possible to optimise helicopter engines by using intercooled cores and intercooled recuperated cores in the future.

In addition, efforts aiming at the increased utilisation of **electrical energy** on board of aircrafts (More-electric Aircraft), have also already yielded initial system solutions (e. g. Boeing 787 or Airbus A350). This development will continue and will increasingly also focus on the engines. In about 40 years we can anticipate the realisation of the first serial **hybrid engines** in airplanes, even on long distance flights. In those, an on-board gas turbine that always works in the opti-mum RPM range will generate electrical energy through a generator and the propulsive thrust will be created by propellers or fans driven by electrical engines. The electrical lines of these sys-tems will be based on high temperature supra conductors cooled with liquid nitrogen.

Pure electric engines will also be available for air travel and they will not require a gas turbine on board. First manned prototypes that are powered by batteries and fuel cells have already taken to the air. The first passenger carrying electric airplane in the world – prototype MB-E1 – was built as early as 1973 and was powered by nickel cadmium batteries. Fully electric engines powered by batteries are feasible even for use on commercial regional aircraft (with ranges of several hundred kilometres), provided the weight related storage density of the batteries can be increased by a factor of at least 5 – 10 compared to those available today. Experts do not rule out this possibility. The contemplated system solutions call for the replacement of the battery packs after every landing with completely charged packs. If these batteries could also be pow-ered with renewable electricity, an important contribution to sustainable air travel could possibly be made in just 25 years.

THE EUROPEAN ETCETERA PROJECT

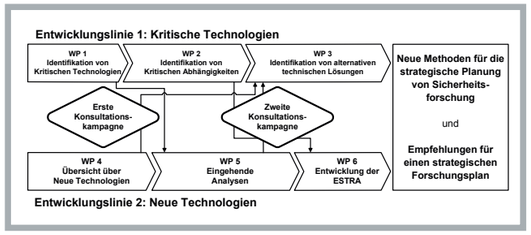
Dr. Joachim Burbiel, Dr. Guido Huppertz, Dr. Ruth Schietke

From October 2011 to November 2013, scientists at Fraunhofer INT conducted the international research project ETCETERA (Evaluation of Critical and Emerging Technologies for the Elaboration of a Security Research Agenda) as part of the European Security Research Programme. Apart from Fraunhofer INT, Fraunhofer ISI and 12 more partners from a total of seven countries participated in the project.

The project had two objectives:

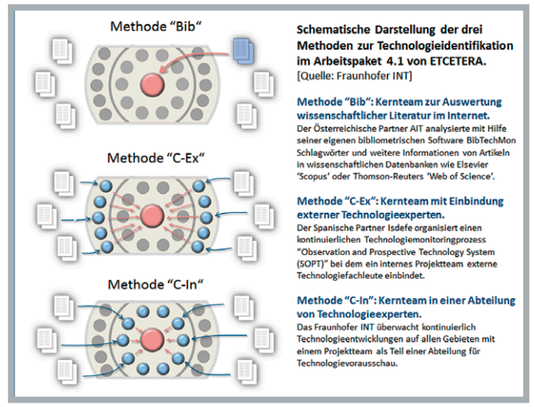
- to develop research plans to reduce critical dependencies and to use the opportunities that emerging technologies offer
- to develop and test new methods for research planning

The focus was also set on two content points, as seen in the project's two lines of development (Figure 1). In Strand 1 "Critical Technologies" such technologies were initially identified that are essential for the function of European security organizations. The next question was whether these critical technologies can be deployed by European industry alone or whether non-European actors are necessary ("Critical Dependencies"). Finally, some of these critical dependencies were examined more closely and proposals to reduce the dependency were made.



The view from Strand 2 "Emerging Technologies" whose Work Packages 4, 5 and 6 were conducted by Fraunhofer INT staff, was aimed further into the future. Work Package 4 first created an overview of those emerging technologies which could have an impact on European security in 10 to 20 years. The search was mainly for ways to increase security for the citizens and for opportunities for Europe's security industry.

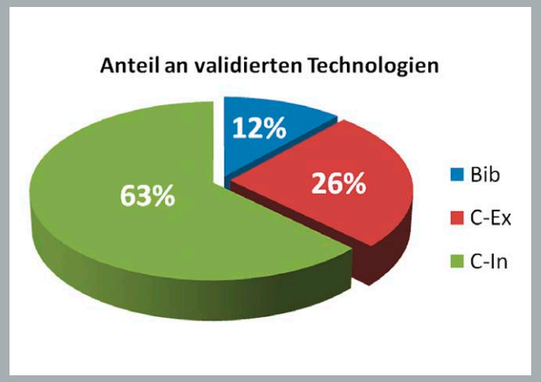
Three different methods were applied in parallel to this end (Figure 2). This served to ensure meaningful results, and to create the basis for a critical comparison of methods. Finally, a recommendation to improve the technology forecasting methodology was derived from this evaluation.

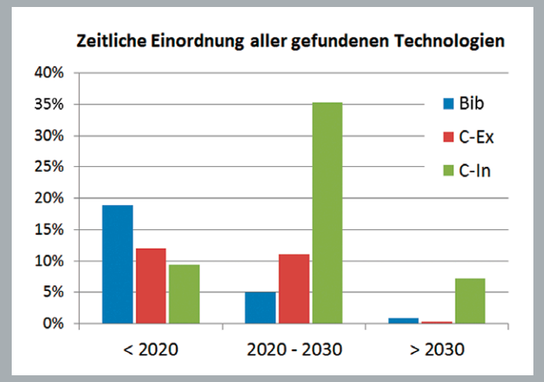


Three steps led to the creation of a list of relevant technological developments:

1. Writing three independent technology lists, using the various methods
2. Collecting and sorting the issues found in a provisional overall list
3. Prioritization of issues in line with the project contract

To summarize the results of the three technology lists, the identified themes were first sorted into overriding theme groups and evaluated for thematic overlap. This was necessary because for emerging technology developments, fixed and uniform terminology has often not yet established. An interesting result in comparing the three lists was the realization that the methods had identified largely differing technologies, both in terms of





the individual subjects as well as their level of aggregation or granularity. Of the 132 technologies identified in the individual lists, 127 were included in the provisional overall list as separate topics. Thus, contrary to the original expectations, there was very little overlap in the results of the three methods.

In the next step, the technologies of the total list had to be validated. To this end, experts were asked to assess the extent to which a technology might be security-relevant and whether market-readiness can be expected within the targeted time window (2020 – 2030). For this purpose, the Weighted Bit Assessment Method (WBAM) for assessing hazardous substances, originally developed at Fraunhofer INT, was adapted. With this system, it was very quickly and efficiently possible to include a large number of experts from different disciplines in the assessment of the technology list. Technologies identified as valid could easily be classified, depending on the resulting average values for the collected parameters, e.g. on the basis of security application relevance or assessment of the application potential. At the same time, this provided the basis for the final comparison of the methods. The above graphs show the percentage of technologies classed as relevant and their temporal allocation depending on the method which found the technologies. The comparison of the methods clearly demonstrates the technology monitoring performance capacity operated at Fraunhofer INT.

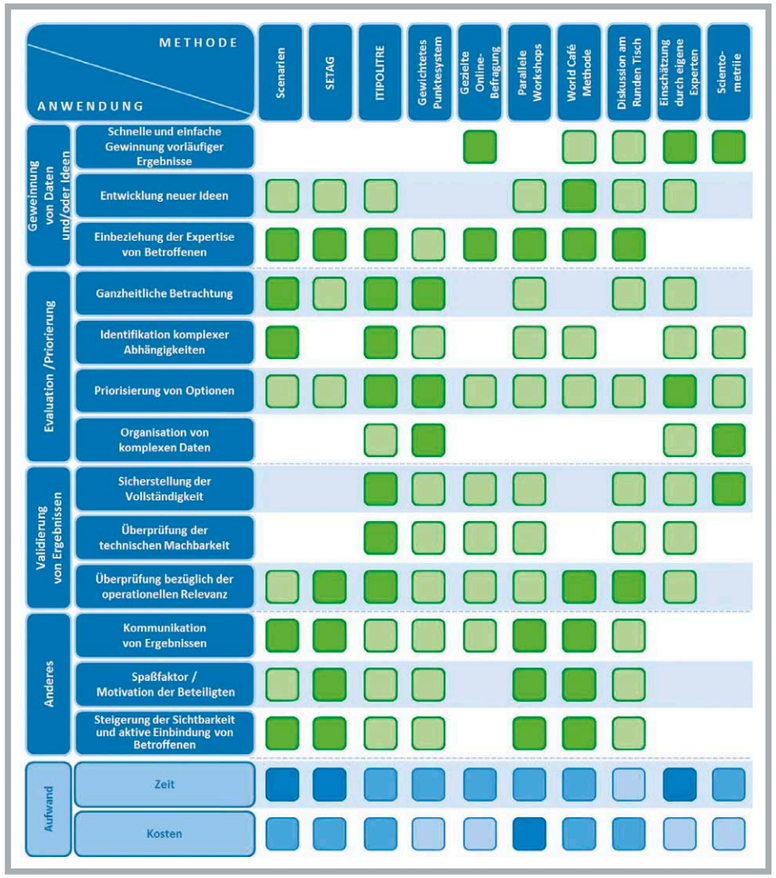
In Work Package 5, nine selected technologies were examined in depth (navigation in enclosed spaces, intelligent textiles, energy harvesting in low performance ranges, homomorphic encryption, integrated sensors for detecting traces of explosives, sensors on unconventional substrates, cognitive radios, terahertz technologies, identification of unconventional threats). A complementary approach was chosen to this end: first, individual experts analyzed selected technologies in greater detail; secondly, they were evaluated in collaborative form. For this purpose, a complex scenario process on future security technologies was carried out under the leadership of Fraunhofer ISI. Separately, the military simulation Disruptive Technology Assessment Game (DTAG), co-developed by Fraunhofer INT, was adapted to the needs of civil security organizations. The new Security Technology Assessment Game (SETAG) was tested in two workshops in Spain and the Netherlands. In addition, an Ethical Helpdesk was installed as a consultant service on all ethical issues and which also generated a fundamental analysis of the ethical and legal issues related to new security-relevant technologies.

At the end of Strand 2 “Emerging Technologies”, Work Package 6 findings on recommendations for the development of the Emerging Security Technology Research Agenda (ESTRA) were compacted. European and national security research programmes were also analyzed in order to ensure maximum compatibility.

The activities of the development lines were flanked by two consultation campaigns, in which the course of the project was discussed in an innovative way with a wider public. During the first consultation campaign five “parallel” workshops were held, in which new ideas were generated for both lines of development. The special feature of these events was that they were conducted in five European countries in the local language (Germany, France, Spain, Italy and Sweden). However, the same procedures were applied everywhere in order to achieve comparable results.

Three strategies were applied in the second consultation campaign. In addition to the scenario and SETAG workshops mentioned above, the Weighted Scoring system developed at Fraunhofer INT for assessing critical dependencies, was adapted and used as a coordination tool for the first line of development.

In addition to the immediate results on critical and new technologies, an outstanding feature of the ETCETERA project was the adaptation and implementation of a variety of methods. Based on the lessons learned, recommendations for future research planning results could be made (Figure “Methods Matrix”).



BUSINESS UNIT “PLANNING, PROGRAMS AND STRUCTURES IN RESEARCH AND TECHNOLOGY”

Dr. Joachim Schulze

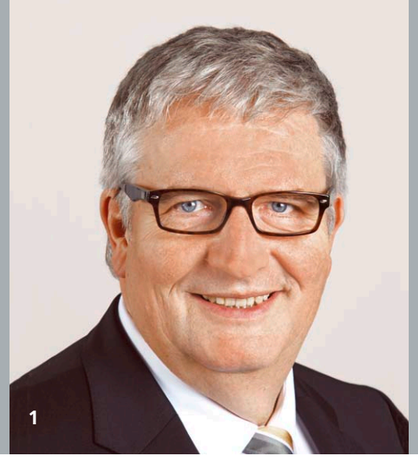
In this Business Unit, the Department “Meta Analyses and Planning Support” develops and applies methods for Research, Innovation and Technology Planning (RIT-P) for ministries, public authorities, industry and European organizations such as the European Commission and the European Defence Agency (EDA). Considered are developments in the scientific and technical fields, programmes and structures in other countries, the EU and the UN, as well as the future needs of different customer groups, so that decision-makers can be provided with a comprehensive overall picture as a basis for recommendations for developing and enhancing their RIT-P. A broad-based knowledge of the research landscape and good networking play a major role for this work (including the Commission on Civil Protection of the Federal Ministry of the Interior (SK), their Ad Hoc-Working Group to assess potential biological threat situations, the Horizon 2020 Secure Societies Advisory Group, the Scientific Committee of the Science & Technology Conference of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), national experts for the Test-Ban Treaty CTBT, the EOS Aviation Security Working Group, German Institute for International and Security Affairs SWP – Working Group Nuclear Proliferation, EDA and LoI6 R&T Points of Contact). We continue to represent the Fraunhofer Group for Defense and Security (VVS) in the EUROTECH Security Research Group of the European Association of Research and Technology Organisations (EARTO) and in the European Organisation for Security (EOS).

Research work is performed by our team of scientists from various disciplines, including biochemistry, biology, biotechnology, chemistry, geophysics, geography, history, computer science, mathematics, pharmacy, physics, environmental engineering, economics and commercial informatics. With this wide range, we are able to assess the feasibility of greatly varying research projects from a practical viewpoint and to offer support on decisions for market launches.

In 2013, planning support instruments were developed further and the method spectrum was expanded. Work included comparative analyses, qualified expert interviews, scenario development, technology road-mapping, text mining, bibliometrics and wikis as well as the adaptation of military methods of capability development to requirements of civil security research or research for a European crisis management. One focus of our work last year was in research for defence against biological hazards as well as for the detection of anti-personnel landmines and unexploded ordnance (EU-FP7-project D-BOX, see below and the separate technical paper in this Annual Report). In the past year, such a scenario study in the field of biological hazards, “Pandemic influenza in Germany in 2020”, was developed and published in collaboration with Zukünftige Technologien Consulting (ZTC) of the company VDI TZ GmbH (see the separate technical paper). This study identified pandemic influenza challenges that can be expected in the future and outlined action options for better readiness to deal with the situation. Our expertise in the social realization or perception of threat and security – vital to the success of innovation processes in security solutions – was widened in various projects and project proposals.

The methods described and long years of experience provide research planning and management support for Federal Ministries (Defence – BMVg, Education and Research – BMBF, Environment, Nature Conservation, Building and Nuclear Safety – BMU), Federal Authorities (Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support – BAAINBw, Federal Office of Civil Protection and Disaster Assistance – BBK, Federal Agency for Technical Relief – THW), national (SK) and international organizations (EDA, CTBTO, NATO) and industry. An example is advising the Federal Government on the scientific and technical evaluation of measures in nuclear safety and disarmament. This is done in collaboration with the Business Unit Nuclear Security Policy and Detection Procedures NSD.

Planning support for the Federal Ministry of Defence plays a special role. As well as direct support in research planning, there is also participation in the planning process and in



committees (R&T Directorate, Departmental Research). Moreover, there is indirect support through contributions to the Defence Technologies Forecast WTV, for which the Business Unit Trends and Developments in Research and Technology is responsible.

Additionally, our Business Unit has responsibility for the production of the Defence Ministry's annual report on defence science research "Wehrwissenschaftliche Forschung". The Ministry of Defence has further tasked the Unit with observing the international research and technology landscape in defence. Current analyses are focusing on the USA, Brazil and India, for example.

In European security studies (EU 7th Research Framework Programme) 2013 saw, among others, the successful conclusion of the ETCETERA Project (Evaluation of Critical and Emerging Technologies for the Elaboration of a Security Research Agenda) as consortium leader (see technical paper in this annual report). Following the recent acceptance and completion of contract negotiations for DRIVER (Driving Innovation in Crisis Management and European Resilience) – the largest single research project in EU security research to date – we now expect to launch this major Phase II European crisis management demonstration project in early 2014, with 37 partners and a total of about € 45 million. Here, we are the scientific manager.

As consortium partner, we have also been involved in the following EU projects:

- ETTIS (European Security Trends and Threats in Society),
- INNOSEC (Innovation and Research in Security Organisations),
- D-BOX (Demining Toolbox).

The EU-FP7 negotiations on the project SOURCE (Virtual Centre of Excellence for Research Support and Coordination on Societal Security) were successfully completed, and work began in January 2014.

Also, the first preparatory talks have begun on Horizon 2020, the new EU Research Framework Programme. Here we will be particularly active in the research area of "Secure Societies".

Again, we successfully carried out the SoBID Project (Stand-off Bio Detection) for the European Defence Agency EDA (see the special paper in this Annual Report).

Finally, a clear account of European security research can be found on our website "esfo – Europäische Sicherheitsforschung": www.sicherheitsforschung-europa.de.

As well as "everyday" research, we were largely busy with the INT strategy process in 2013. We critically evaluated our strengths and weaknesses and our market-related opportunities and risks, and realigned ourselves accordingly. An important result was the merging of the departments AP (Meta-Analyses and Planning Support) and TAV (Technology Analysis and Foresight), operative as of January 2014. This will allow us to better exploit synergies and better meet individual customer needs, thus doing justice to our concept of continually improving our performance, and giving us a confident start to the year 2014.

1 *Dr. Joachim Schulze*

INFLUENZA PANDEMIC IN GERMANY 2020 – SCENARIOS AND ACTION OPTIONS

Dr. Ruth Schietke

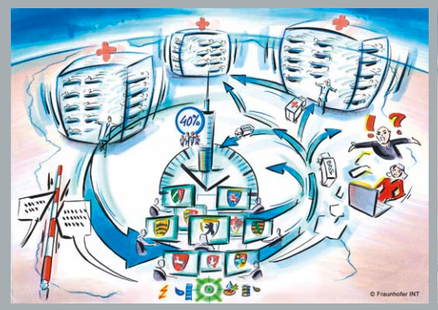
For some considerable time, Fraunhofer INT has actively supported security research planning with regard to the danger potential from chemical and biological agents. As part of this work, Department AP (Meta Analyses and Planning Support) conducted the study "Influenza Pandemic in Germany 2020 – Scenarios and Action Options", publishing the results in 2013.

At the end of the 1970s, major pandemics were largely considered to be a thing of the past. Today, however, we can see that old and new infectious diseases again need to be regarded as a considerable problem. This is largely due to the often rapid spread of such pathogens in the wake of growing globalization. In 2009/10, the H1N1 virus showed just how quickly just about everyone can suffer the effects of influenza. Against this background, the study addressed the issue of pandemic influenza proactively, analyzing the long-term challenges that could face Germany, as well as developing steps to improve preparedness for the next pandemic and how to deal with it.

The study generated three future scenarios: *crisis signs despite controllable pandemic situation, poor preparation leads to crisis in Germany,* and *we are ready for anything*. This was the starting point for the subsequent detailed investigation of the effects and dangers of a pandemic. The scenarios were generated in cooperation with VDI TZ utilizing the established scenario technique, which is an important instrument for prognostics at the INT. A timeframe of 10 years was chosen, as it can be assumed that during this time the relevant social, technological and organizational circumstances that affect the course of a pandemic influenza will have changed considerably, for example the use of new media and information channels, or the demographic change.

At Fraunhofer INT, the three scenarios were analyzed in a workshop with experts from research, industry, public authorities and organizations concerned with security. The agenda covered possibilities for lasting improvements for pandemic prevention and management in Germany. This produced six courses of action:

- *Anti-epidemic Preventive Measures* include giving the public timely and comprehensive information on the correct behaviour for avoiding infection.
- *Anti-epidemic Measures during a Pandemic* aim at speedily halting the spread of disease, for example by avoiding physical contact, crowds or public transport, even going as far as curfews, changing travel patterns or closing schools.
- *Improving Crisis Communication*, which means informing the public as early and comprehensively as possible, giving them plausible details of the situation, also by continually adapting crisis communication to new technology and media platforms such as the social media. The new media should also be monitored preventively and evaluated. In addition, even during their training, doctors should learn how to improve the communication skills that a pandemic requires.
- *Intensifying Training Programmes* to instruct medical teams and hospital staff in necessary procedures for dealing with highly contagious diseases. This calls for regular training, also using virtual training platforms.
- *Improving Strategic Measures for Pandemic Preparedness* means securing adequate stocks of consumables and equipment, as well as the optimum distribution of medical teams and material. Business companies also need to develop their own pandemic plans and train their employees.
- *Prevention by Vaccination* requires more positive public debate, so that more people get vaccinated. In a health care system, a vaccination strategy calls for clearly defined rules about who is responsible for what, for example who pays the costs and which doctors carry out the vaccinations.



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These proposals are of great importance for giving the public the best possible protection against the risks of a pandemic. Many of them are already valid or can be realised today. They serve both prevention against and preparation for a possible influenza pandemic.

At the least, these proposals should be an impulse and a discussion basis for those responsible in government, industry and society for developing and optimizing public protection against pandemics in the coming years.

Further details on the study and its results have been published in "Influenza Pandemic in Germany – Scenarios and Action Options".

1 *Scenario 1 "Signs of crisis despite manageable pandemic influenza incident". A flow of supply and crisis management is basically present. Information reaches the authorities in real-time and the corresponding measures follow. However, instead of regulation at a higher level, they are initiated at district or local authority level. A border-crossing crisis management concept does not exist. Drinking water, energy, food and fuel supplies are assured. The hospitals are overcrowded. The public is nervous because of bad communication and the lack of information.*

2 *Scenario 2 "Poor preparation leads to crisis in Germany". There is no supply flow or crisis management. Instead, crisis management is disorganised and uncoordinated. General supply through public safety bodies is decentralised and without any prioritisation criteria. Hospitals do not have capacity for the rising numbers of patients. Moreover, drug supplies are soon exhausted. The death rate reaches 103,000. Less than 15 % of the population is vaccinated. Panic buying, restricted infrastructures such as telecommunications and resultant public anger lead to a highly-charged atmosphere.*

3 *Scenario 3 "We are prepared!" The supply flow and crisis management run without hindrance. There was forward-looking planning in non-crisis times. Permanent and trans-regional stockpiling as well as a centrally regulated distribution system ensure a comprehensive supply of such resources as technical equipment, drugs and personnel. Patient care in hospitals proceeds smoothly. More than 40 % of the population is vaccinated. Drinking water, energy, food and fuel supplies are ensured. Only the negative impact on everyday life, such as restricted mobility in public transport, causes public dissatisfaction.*

FP7 INTEGRATION PROJECT D-BOX (DEMINING-TOOLBOX)

Kay Uwe Suwelack, Dr. Sonja Grigoleit

"Development of a comprehensive toolbox for the detection and neutralization (humanitarian demining) of anti-personnel mines and cluster munitions on civilian land"

Summary

Landmines and cluster munitions kill or maim people every day, even long after the actual conflicts have ended. This burning issue of anti-personnel mines and cluster munitions is dealt with by the FP7 Integration Project D-BOX ("Comprehensive toolbox for humanitarian clearing of large civil area from anti-personnel landmines and cluster munitions").

Part of the project is the development of an innovative solution that offers mine seekers a "toolbox" with the best tools, methods and procedures. This smart toolbox can be applied throughout the demining process, from preparing the mission to eliminating the mines as well as communicating with the general public and donors. The toolbox should be inexpensive, easy to use and adapted to different scenarios and environmental conditions.

The toolbox will also include an information management system in accordance with International Mine Actions Standards (IMAS), which will satisfy the operational need for accurate, reliable and timely information.

Introduction

The D-BOX Project began in 2013 as part of a three-year FP7 Integration Project (FP7 research call SEC-2011.01.03-3), with 22 partners from 11 EU Member States and a budget of approximately € 10 million. The objective is to further develop and integrate existing methods and procedures for detecting land mines in an easy-to-use toolbox.

Background

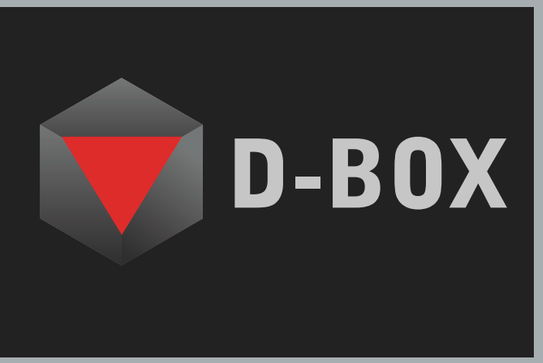
According to current estimates, approximately 110 million landmines have been scattered and buried in about 70 countries since 1960. With current global financing and support for demining projects, approximately 500,000 of these mines can be found and neutralized each year. However, even assuming that as of now no new mines are laid, it would still take about another 100 years to safely defuse and remove all the mines already in the ground. Meanwhile, the remaining mines kill or maim 15,000 to 20,000 victims per year worldwide, also hindering the economic development necessary to guarantee peace and prosperity in conflict and crisis areas.

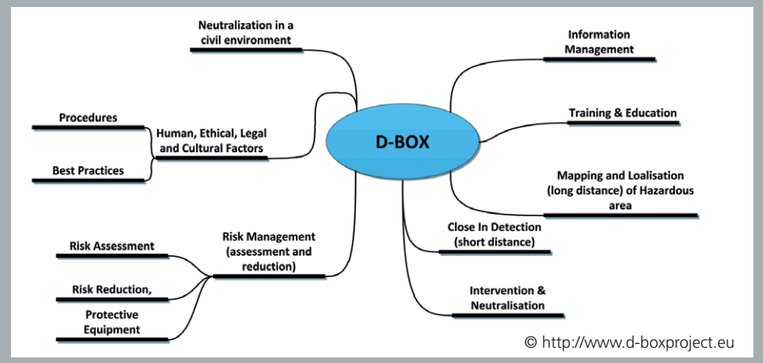
The detection and neutralization of a single anti-personnel landmine costs between € 200 and € 750 today. This means that the cost of clearing a square kilometre of useable land is between € 2 and € 8 million. As the EU Commission and the EU Member States are already among the largest donors in humanitarian demining, there is very great interest in reducing the unacceptably high costs, by increasing efficiency at all levels of demining processes and procedures.

Operational Requirements and D-BOX Approach

The actual operational needs and priorities for improving efficiency were developed and summarized some time ago by the international Humanitarian Demining Community. Among the organizations involved are:

1. the national Mine Action Centres (MACs) of affected states,
2. the Mine Action Service of the United Nations (UNMAS) and
3. the Geneva International Centre for Humanitarian Demining (GICHD).





STAND-OFF BIODETECTION?

Dr. Silke Römer, Dr. Joachim Burbiel

Biological weapons have become a potential threat for both military and civilians. An early warning of a biological attack is indispensable and fundamental to establish a timely defence, to maintain and support effective operability of security forces, and to initiate civil protection measures.

The SoBID (Stand-off BIoDetection) project funded by the European Defence Agency aimed at delivering insights on potential future technological solutions for stand-off bio detection within a timeframe of 10 to 20 years from now. To achieve this, the project team checked the scientific plausibility of technological stand-off solutions proposed in the context of bio detection. The approach chosen for this study by Fraunhofer INT together with two Spanish partners, Isdefe and IBATECH Tecnología, was based on desktop research on the state-of-the-art of technologies and systems related to stand-off bio detection, combined with an information exchange workshop and complementing expert input / interviews.

At the beginning of the project, the technologies applicable for stand-off bio detection were clustered on the basis of a desktop research technology scanning (see illustration). All of these technologies were characterised, describing the principle of the technologies, considering assumptions of military needs and requirements, taking into account different scenarios of application, and identifying relevant stakeholders and research & development / research & technology programmes. Although no constraints concerning specific scenarios or missions were applied, the study concentrated on situations where biological hazards appear in the form of aerosols, as in other cases (e. g. surface, food or water contamination) a stand-off capability is less crucial.

One difficulty encountered by real-time stand-off detection of biological threat agents is the fact that once an aerosol has been released, its intensity can change significantly due to environmental conditions such as rain, wind, etc., and its concentration may be very low compared to the background. Furthermore, from today's point of view, is seems to be impossible to discriminate between pathogenic and non-pathogenic bio-materials without getting into contact with a sample, and there is no technology on the horizon to overcome this shortcoming.

The SoBID team suggested a twofold solution to this severe limitation:

- A system of systems solution, combining two or more technologies.
- A dual system capability: A stand-off warning system and a remotely controlled biological point-detection system for identifying pathogens.

Starting with the complete range of technologies taken into account for the state-of-the-art description, a combination of the most promising technologies in terms of maturity and operability were chosen to develop roadmaps. Two combinations of "real" stand-off technologies and one example for remotely controlled biological point detection have been selected for detailed roadmapping:

- Stand-off demonstrators:
- UV LIF LIDAR with WANDER LIDAR with DISC
- DIAL LIDAR with WANDER LIDAR with DISC
- Remotely controlled biological point detection demonstrator with sampler for PCR

Combining the technologies described in the stand-off demonstrator roadmap, advancements in individual performance and complementarity make it possible to expect a stand-off technology demonstrator that can provide a "detect to warn" capability at stand-off ranges (5 to 10 km) and some classification capabilities with reasonable reliability and accuracy in a ten year perspective.

However, additional actions, which are not strictly technological developments, need to be undertaken in order to provide full operational capability. Firstly, detailed knowledge on normal background, fluctuations and patterns is a prerequisite for

The following essential requirement priorities were worked out:

1. improvements in locating and marking hazardous areas
2. the availability of low cost, efficient and easy-to-use devices for local mine detection.

These key requirements were confirmed after the involving D-BOX project end-users and in talks with GICHD.

The D-BOX project addresses these questions with a comprehensive, innovative and simple approach which includes the integration of innovative solutions, i.e. technologies and methods for (i) mapping, (ii) long-range detection, (iii) short-range detection, (iv) neutralizing mines in a civilian context, (v) developing protective equipment for end-users and the civilian population and (vi) obtaining knowledge about the risks of landmines and existing safety rules. In essence, the toolbox will consist of an Information Management System (IMS) which matches IMAS standards for humanitarian demining and meets existing requirements for providing sufficient, timely, accurate and reliable information at all stages of the clearing process. In this context, already existing IMS procedures and databases are also to be integrated into the Toolbox or linked to it.

The D-BOX project began in 2013 with a comprehensive study on the state of the art and on existing standards in humanitarian demining. In addition, various toolbox application scenarios were developed. As well as developing the IMS described, the project carried out more research and development in:

a. biosensors for short-range detection of landmines
b. the operational capabilities of sensor networks
c. risk management techniques
d. training methods for tracker and search dogs, and
e. methods and techniques for information infusion.

The results of this work and the functionality of the toolbox are to be investigated in a series of demonstrations in 2015, followed by evaluation and assessment with a view to subsequent commercialization.

Literature

[1] Geneva International Centre for Humanitarian Demining (GICHD): "Mine Action Equipment: Study of Global Operational Needs", June 2002

[2] N.E. Walsh & W.S. Walsh: "Rehabilitation of Landmine Victims – the Ultimate Challenge", Bulletin of the World Health Organization, Vol. 81, No. 5, pp. 65 – 70, September 2003.

[3] International Campaign to ban Landmines: Landmine Report 2009.

1 *D-BOX Logo*

2 *Basic structure of the Demining-Toolbox (D-BOX)*

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stand-off bio detection, as the amount of biological material posing a threat in relation to measurable signals and signal to noise ratios is a principal limitation for stand-off bio detection capabilities. Secondly, systematically defined and commonly shared testing conditions should have high priority. This aspect includes the need to standardise and raises the question of test facilities. Relevant tests conducted so far have taken place outside the EU.

Factors beyond the scope of this study determine the pros and cons for initiating necessary additional actions (e. g., shared test and evaluation facilities), i.e. the assumed type of missions, the financial framework, the perceived threats and risks with respect to biological agents (including type, amount and distribution means), the perceived threats and risks in relation to other threats and risks, and the resulting operational needs and political decisions.

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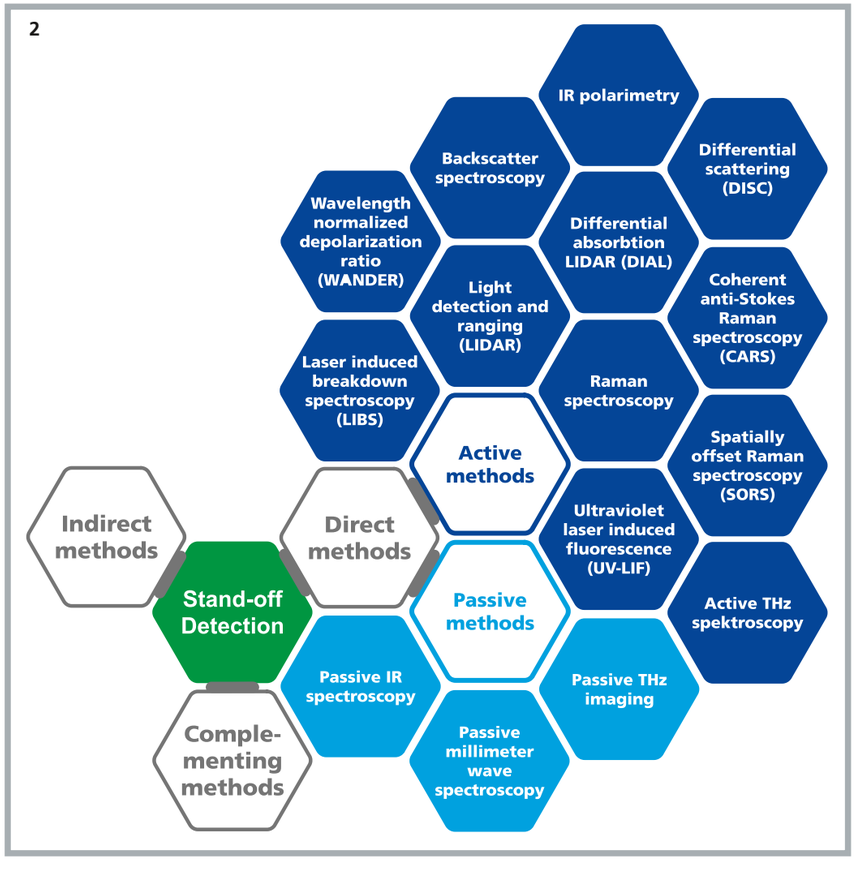

1 *SoBID Logo*

2 *Overview of stand-off-detection methods (excerpt)*

BUSINESS UNIT “NUCLEAR SECURITY POLICY AND DETECTION TECHNIQUES“

Dr. Theo Köble

The Business Unit “Nuclear Effects and Detection Systems“ (Nukleare Sicherheitspolitik und Detektionsverfahren – NSD) carries out theoretical and experimental research and development in the fields of nuclear security policy and nuclear detection systems. As well as basic studies, research projects are conducted for industrial clients (nuclear research and technology) and public bodies (mainly for offices and organizations concerned with security, and major research centres). With basic funding from the Federal Ministry of Defence (BMVg), NSD also deepens and expands the national ability to discern threats from nuclear and radiological weapons and associated asymmetric areas. For simulating physical processes, a Linux cluster with 64 processor cores is available. In addition to coupled neutron and gamma transport calculations, e. g. for simulating detector spectra, coupled neutron and hydrodynamics calculations are performed. Several neutron generators (14 MeV and 2.5 MeV) and an isotope laboratory are used in research work.

Occasionally, the isotope sources and experimental facilities are also made available to external users for their own investigations. For the safe operation of these irradiation facilities and for handling the many radioactive substances, INT has the appropriate radiation protection infrastructure and a permit to operate in third-party nuclear facilities (such as research reactors and nuclear power stations). All experimental work is supported by precision mechanics and electronics laboratories.

Potential developments in nuclear disarmament and proliferation – in the main technical but also political – were continuously monitored. These are analyzed with special emphasis being laid on physical and technical aspects. In this context, for example, there was a visit to the George Washington University in Washington, USA, for the “Short Course on Nuclear Weapon Issues in the 21st Century”. In particular, nuclear developments were also observed, analyzed and evaluated in Iran and North Korea. As part of the work in the ESARDA Working Group on Verification Technologies and Methodologies (VTM) – organized by the Non Proliferation and Nuclear Safeguards Unit at the Joint Research Centre in Ispra, Italy - NSD reviewed developments in international disarmament treaties, including export controls and new safeguard technologies for the IAEA.

In September, the Institute conducted the 6th Symposium on “Nuclear and radiological threats”, an event that attracted great interest. This bi-annual symposium monitors the national level of knowledge on the subject (see separate report page 66).

For the prevention or early detection of terrorist action with nuclear or radioactive material, state-of-the-art systems for the non-destructive detection and identification of such materials were examined on location for their suitability.

The Business Unit continues to be a partner in several international projects dealing with CBRN threats and counter measures, contributing to the radiological (R) and nuclear (N) aspects of each consortium. Brief presentations of these projects follow.

The German-French project ANCHORS (UAV-Assisted Ad Hoc Networks for Crisis Management and Hostile Environment Sensing) aims at developing a cooperating swarm of UAVs (unmanned aerial vehicles) and UGVs (unmanned ground vehicles) to obtain a comprehensive picture of the situation in the event of a disaster. The optocopter UAV should also be able to detect radioactivity and be used as a relay station to secure smooth communications. Halfway through the project, the Early Demonstrator was presented in France, showing the operability of essential components, partly newly developed. At the end of the project, a fully integrated functional model should be available.

The year saw the completion of the project “Ukrainian Border Crossing Station”, conceived to improve the fight against smuggling radioactive and nuclear materials past Ukrainian border posts. This project is part of TACIS, the European Commission’s programme for Technical Assistance to the Commonwealth of Independent States. Promoter is the European Joint Research Centre in Ispra, Italy. A joint effort by INT, the border stations

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and the detector supplier, the project included tests on the new detectors at Ukrainian border crossings, to ensure correct installation and functioning (see separate report page 43).

Four experts from NSD cooperated in the ITRAP+10 programme (Illicit Trafficking Radiation Assessment Programme), which conducted experiments on the performance of currently available radiation detection systems for border posts, comparing them with existing standards.

Together with French experts from ISRN (Institut de Radio Protection et de Sûreté Nucléaire), INT's experts were tasked with validating the test methods developed for the project by the Joint Research Centre of the EU (JRC), the International Atomic Energy Agency (IAEA) and DNDO, the Domestic Nuclear Detection Office that belongs to the US Department of Homeland Security.

The major EU project EDEN (end-user driven demo for CBRNE), which aims to demonstrate a comprehensive system of measures against CBRNE attacks or accidents and their consequences, was launched in September. More than 30 partners from throughout the EU are participating in this project. One task for the Business Unit is analyzing needs and gaps for the end-users, which involves the results of earlier EU projects. The analyses are being extended by the use of end-user workshops, specifically developed in several EU states. NSD continues to be active in developing RN scenarios, and will take part in future RN demonstrations, including participation under the aegis of INT in a demonstration on nuclear smuggling. The aim of the demonstrations is to point up the effective interaction of the comprehensive system of measures to deal with CBNE attacks and accidents, and to close gaps through systems newly developed within the project.

In the EU-FP7 project Scintilla (Scintillation Detectors and New Technologies for Nuclear Security), the Business Unit is involved in developing new detector technologies on the basis of scintillators for radioactive and nuclear substances that are difficult to detect. The project is also looking for a suitable substitute for the meanwhile prohibitively expensive neutron detection substance He-3, used in many safeguard systems based on revealing neutrons.

1 *Dr. Theo Köble*

SECURING THE EU-UKRAINE BORDERS AGAINST SMUGGLING RADIOACTIVE OR NUCLEAR MATERIAL – A TACIS PROJECT

Dr. Sebastian Chmel, Dr. Monika Risse, Dipl.-Phys. Wolfram Berky

Introduction

Smuggling and the possible misuse of radioactive or nuclear materials have long been the subject of general concern, especially after several cases of illegal possession of highly enriched uranium were discovered in the 90s. The theme has not lost its explosive nature, especially given the ongoing global terrorist activities.

In this context, particular attention has to be paid to the countries of the former Soviet Union: after the collapse, an advanced nuclear industry had to be reorganized. Nuclear safety is therefore also a focus of the European Union's TACIS program (Technical Assistance to the Commonwealth of Independent States), the world's largest program in support of the countries in the CIS (Commonwealth of Independent States). The project "Ukrainian Border Crossing Station" of this program, was dedicated to the fight against smuggling radioactive or nuclear material across the borders of Ukraine into the EU. Apart from the difficult political and economic situation, the Ukraine is also important as a transit point between Asia and Europe in this context. The border stations are therefore being supported internationally – especially also by the United States (Second Line of Defense Program) – with radioactivity detectors. The TACIS project "Ukrainian Border Crossing Station" (duration: 2009 – 2013) served the installation of such detectors at three selected border stations.

Fraunhofer INT acted as lead manager and, together with the Federal Institute for Materials Testing (BAM), supported the Joint Research Centre of the EU in the corresponding measures. These included both metrological and methodological issues, and the training of border officials.

Selecting and Installing the Detectors

After a general situation analysis, person and vehicle control processes and the layout situations were observed at selected border stations, followed by generating concepts for integrating the detection systems in the control architecture at the borders. Subsequently, the Joint Research Center launched a Europe-wide invitation for procurement tenders for the measuring instruments, based on technical performance specifications and situation-specific requirement profiles developed by Fraunhofer INT. The emphasis was on the installation of portal monitors for detecting gamma and neutron radiation. Because of the financial limits, the procurement of handheld instruments was postponed to a later date.

Finally selected were YANTAR portal monitors from the Russian company ASPECT. The full installation of the measurement systems was carried out by the Ukrainian company ASPECT Service Ltd. This included both detector installation and the corresponding equipment for remote monitoring from a control room, plus an introduction and a training program for border guards. Figure 1 shows a portal monitor column, framed by black and yellow striped concrete pillars to prevent damage to the detector from badly driven vehicles. To control vehicles, the road is flanked left and right by such a detector column; a single smaller version column suffices for pedestrian control. If a radioactive source is detected, a visual and acoustic alarm is triggered both on the detector column (see warning light on the top left column in Figure 1) and in the control room. At the same time, surveillance cameras record images of passing vehicles or pedestrians, capturing a potential cause of the alarm on film and photo.

Acceptance Test and Process Demonstration

After installing the detectors at border stations, detailed acceptance tests were carried out, with Fraunhofer INT experts taking part. Testing was in accordance with the tender's technical specifications, each with a neutron and a gamma ray source (^{252}Cf and ^{137}Cs).

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Very different aspects were taken into account: for example, in addition to the required sensitivity of the detectors, the clear differentiation between neutron and gamma radiation had to be ensured, as was the case with the correct logging of all processes in the automatic data capture, or system stability in a (short-term) power cut, or the connection from portal monitor to monitoring computer etc. The sensitivity of the system was determined both in the so-called static tests, in which the radioactive source is stationary, as well as in dynamic tests in which it moves. In the second case, the sources were realistically tested for pedestrian and vehicle, either being worn by a person who walked through, or in a car being driven through at the proscribed speed of 10 km/h. In some cases up to 50 passages were necessary until the required detector sensitivity was established with sufficient statistical significance. Since radioactive background radiation at the various border stations differed considerably, the detector systems had to be set differently. As expected, detector operation at higher and stronger background fluctuation rates was more difficult because besides sufficient detection sensitivity, a low false alarm rate is essential. Otherwise, border traffic would often be hampered without reason, which ultimately can mean that the alarm will not be taken seriously enough (or the system might even be removed).

It became apparent that besides technical aspects, spatial arrangements and processes in the environment also have a great impact on the operational capability of the detector system. For example, for a correct measurement, the time a vehicle remains between the portal columns must be limited, something which cannot be readily ensured in peak traffic times. This makes special measures necessary (ideally traffic lights).

In addition to the acceptance tests, the entire process was demonstrated in a smuggling attempt exercise at one of the border stations, from the alarm being triggered and the detailed search of vehicle and its occupants, to the seizure of radioactive materials.

The high willingness to cooperate and the trust shown by the Ukrainian border police (State Border Guard Service) – who willingly gave insight into the various processes and locations and showed openness to new ideas – deserves recognition. The close contact between Fraunhofer INT, end users and practice is likely to be of use in future projects.

Training Border Officials

Of course, the procurement and installation of portal monitors is only the first important step to securing border stations against smuggling nuclear and radioactive materials. To operate the systems effectively, the correct use and follow-on action in case of alarm must be assured. This makes necessary the comprehensive training of all forces concerned with the portal monitors themselves, with data acquisition and examining the suspect. As part of the project, a large group of Ukrainian trainers underwent “train the trainer” courses, with the aim of passing on their knowledge and skills to border officials.

The training course was held in the Security Training Center SeTraC of the Joint Research Centre JRC of the European Commission in ISPRA, Italy. It provides the ideal venue, because besides the necessary training facilities, real portal monitors are available, thus allowing practice with radioactive sources. The course included theoretical training as well as practical demonstrations and extensive exercises. The participants learned how to act in case of an alarm at a border crossing. The theoretical background covered fundamental physics, radiation protection, general detection methods for radioactive materials, and nuclear forensics, as well as themes such as the national Ukrainian Action Plan for the case in hand.

The lecturers were mainly provided by the Institute for Transuranium Elements ITU of the JRC; they were able to fall back on documents and experience with similar courses. Ukrainian experts presented the Ukrainian Action Plan and the specific procedures at Ukrainian borders.

The decision-making processes and the information exchange between the participating emergency services and organizations on location and in the Ukraine were dealt with as a table top exercise conceived and conducted by Fraunhofer INT experts. The knowledge the experts gained from their visits to the border stations and their understanding of possible scenarios led to a realistic exercise. The very intensive participation of the trainees was judged very positively by all the organizers.

Summary

Fraunhofer INT was lead manager in the EU TACIS project “Ukrainian border crossing station”. The aim of this project was technical and organizational improvements to combat the smuggling of radioactive and nuclear material at Ukrainian border stations. To this end, portal monitors for detecting such materials were installed at three selected border stations. In addition, Ukrainian border guards were trained in the operation of the portal monitors and in procedures in case of an alarm. With this project, part of a number of foreign assistance programs, another contribution has been made to prevent the smuggling of radioactive and nuclear materials through the EU’s external borders. The four-year project was brought to a successful conclusion in 2013.

1 *Left: pillar of the portal monitor system YANTAR. Next to the portal monitor pillars are concrete protection posts (striped). Right: interior view (left: plastic scintillators for gamma detection, right in white: neutron detectors).*

2 *A test vehicle containing radioactive material passes through a portal at one of the selected border stations.*

BUSINESS UNIT “ELECTROMAGNETIC EFFECTS AND THREATS”

Dr. Michael Suhrke

It is the responsibility of this Business Unit, which receives basic financing from the German Ministry of Defence, to make contributions that enable those in charge to make decisions in reference to potential military threats in the field of electromagnetic effects. Given that this task is handled within the military only up to a certain extent, the EME, in co-ordination with the German Department of Defence and in cooperation with defence sector enterprises conducts its own theoretical and experimental research. This includes the continued development of related measuring technology. Beyond the research for which it receives basic public funding, research projects commissioned by clients outside of the defence industry (civil security research) and industrial projects are becoming increasingly important.

The experimental work conducted by the EME with regard to electromagnetic threats, in particular those originating from high power microwaves (HPM), comprises studies of the coupling of electromagnetic fields to structures and concrete systems as well as the vulnerability of electronics when exposed to high intensity fields. The activities range from investigations of the hazards high power electromagnetics (HPEM) pose for IT devices and systems based on current technology and in particular also for line connected as well as wireless data transmission technology (network technology) to sensitivity tests performed on civil communications and security solutions. Electromagnetic threat detection processes are also subjected to fundamental testing and experimental work, especially with regard to HPM threats.

The EME has at its disposal an in-house developed TEM (Transverse Electromagnetic Mode) wave conductor, which is located in a shielded hall and covers the frequency range from 1 MHz to 8 GHz. The tool makes it possible to perform both, linear coupling measurements that determine transfer functions and electromagnetic compatibility (EMC studies), as well as interference sensitivity tests with constant and pulsed fields with fields strengths of up to several kV/m on object sizes of several m^3. For the handling of measuring assignments outside of the institute, the Business Unit is equipped with a mobile HPM radiation system, which was also developed in-house. It can be used to create field strengths of up to 5kV/m through the radiation generated by various antennae in the frequency range from 150 MHz to 3.4 GHz. These systems are complemented by a mode-stirred chamber fitted with high power sources to generate field strengths in excess of 10 kV/m in the 500 MHz to 18 GHz frequency range in order to cover the growing number of modern sensor and communications technology applications in the higher Gigahertz range. There is also a small absorber room for up to 40 GHz paired with comprehensive high frequency and microwave measuring technology.

As part of NATO STO SCI-250 Task Group “Radio Frequency Directed Energy Weapons in Tactical Scenarios” the Business Unit prepared the joint test campaign RAID for the realistic demonstration of the effects of HPM sources on electronic devices by hosting an event at Fraunhofer INT and actively participated in the campaign. It included a demonstration day attended by the NATO Chief Scientist and led to the production of a professional video, which generated lots of attention on YouTube’s NATOChannel.tv. Moreover, the Business Unit organised two meetings on the standardisation activities of the NATO STO SCI-250 Task Group at the Fraunhofer INT.

In the civil security research field, the EME is a HIPOW Consortium Partner of the 7th Master Program of the European Commission’s Security Research entitled “Protection of Critical Infrastructures against High Power Microwave Threats” under the direction of FFI Norway. In 2013, it prepared and implemented the test campaign DEAR, which conducts HPM sensitivity testing on critical infrastructure components in realistic scenarios inside buildings. HPM sensitivity laboratory testing on critical infrastructure components was also initiated. The Unit is also involved in the German program “Civil Security Research” conducted in conjunction with the German MoD’s high tech strategy, which is part of a cooperative effort of Germany and France in civil security research and includes electromagnetic compatibility testing as a component of the joint project

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HPEM FREE-FIELD MEASUREMENTS IN NORWAY

Dipl.-Ing. Michael Jöster

"UAV-Assisted Ad Hoc Networks for Crisis Management and Hostile Environment Sensing (ANCHORS)". New approaches to HPM source development were examined in an industrial project.

Activities aiming at the further development of a detection system that discovers and identifies HPM threat signals continued in 2013 with the implementation of the capability to recognize the frequency of an HPM attack and the development of a compact version for field testing uses. It was tested in the summer of 2013 in Norway during the DEAR and RAID measuring campaigns. This development was discussed in a report published in the December issue of "Fraunhofer Kompakt" under a heading that translates into "Defending Against Electromagnetic Attacks".

Analytical simulations of the electromagnetic field in the TEM wave conductor were performed based on the "Transverse Resonance Diffraction" method to characterize the TEM wave conductor. The purpose of this is to provide an additional reference point for strictly numeric processes. Studies to obtain statistic descriptions of the field homogeneity and quality of the TEM mode in the TEM wave conductor were performed as part of the further development of the respective IEC standards.

The EME is also engaged in comprehensive standardisation work. Besides work for the NATO and in the DIN working group „TEM Wave Conductor and Reverb Chamber", it also participates in the DIN working group "EMV of Semiconductors," the VG (German defence equipment) standard boards on NEMP, lightning rods and electromagnetic compatibility and is the national representative in the IEC's Joint Task Force Reverberation Chamber.

In 2013, insights into the threats posed by high power microwaves were provided in external topic-related presentations, e. g. at the Directed Energy Systems 2013 Conference in London or at the Progress In Electromagnetics Research Symposium 2013 in Stockholm. At the 8th Future Security Conference 2013 in Berlin, one of the focal points was the HPEM threat, which was covered in a panel discussion and special session, which the Unit organised and was involved in. The Business Unit also made two presentations and chaired a meeting during the Symposium EME 2013 at the Bundeswehr Education Centre in Mannheim.

The EME regularly offers lectures on the field at the Bonn-Rhein-Sieg University. In 2013, a bachelor thesis on the "Optimisation of a Cavity Backed Spiral Antenna" and a master thesis entitled "Comparison of TEM Wave Conductor and Stirred Mode Chamber as Interference Resistance Test Environments for Interference Tests with High Power Microwaves" were completed at the Fraunhofer INT, while another student began to work on a new bachelor thesis on the "Further Development of the HPEM Detector User Interface."

1 *Dr. Michael Suhrke*

One of the highlights of 2013 for Business Unit "Electromagnetic Effects and Threats" (EME) and support group "Scientific-Technical Infrastructure" (WTI), was an unusual business trip to Norway. For three weeks in the late summer, selected electronic systems were tested in various scenarios – with a very likely one-of-a-kind assortment of high frequency transmitters – in the terrain and in empty buildings on a small island in the Oslo-Fjord.

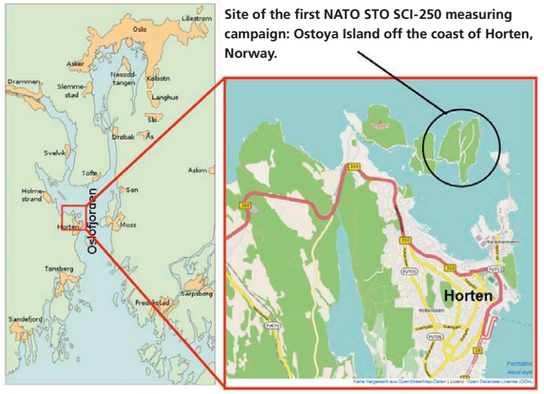
The project specifics had been defined as a goal in 2012 in conjunction with the launch of the NATO working group "STO SCI-250 – Radio Frequency Directed Energy Weapons in Tactical Scenarios." The aim was to verify the results of previous working group activities, which had been conducted independently in various high frequency labs under typical idealised conditions, through a demonstration in potential attack scenario using real HPEM -high frequency sources. They were to be presented to official NATO representatives during a guest event. Car-stopping was also included as a scenario and two used vehicles were acquired for this purpose. What made this demonstration so interesting and unique for Fraunhofer INT was in particular the aspect that the international co-operation in the working group allowed it to co-use a selection of military and non-military HPEM sources with a wide range of high frequency parameters. In the subsequent NATO working group meetings, the demonstration was divided into two events – a two-week European one in 2013 and a one-week one in 2014 in the U. S. – to take the logistics expenditures of the different nations into account. The venues were defined as well. For the European measuring campaign, Norway, with its island off the coast of Horten dedicated exclusively to military uses, which is where the Norwegian Military Research Institute FFI is headquartered, proved to be the perfect host. The U. S. measuring campaign is slated to take place in the 2nd half of 2014 on testing terrain of the Naval Surface Warfare Center Dahlgren Division (NSWCDD).

The objectives of the EU project "Protection of Critical Infrastructures against High Power Microwave Threats (HIPOW)," are identical. It also develops scenarios, in which high frequency sources with similar parameters play a role. The examined electronic systems of civilian critical infrastructure as test subjects are also comparable. Due to the fact that many of the consortium partners who are delegates to the HIPOW project are also members of the "NATO STO SCI-250" working group – especially given that the FFI is managing the EU project – the decision was made to combine a one-week measuring campaign for this EU project with the two planned weeks of measuring in Norway for the "NATO STO SCI-250".

At Fraunhofer INT, the planning work began at the end of 2012. One of the electronic devices to be tested was the 4-channel HPM detector to be made for HIPOW. By the summer of 2013, once the concept had been defined, the WTI workshops had built a high frequency resistant housing with integrated electronics and power supply. Its functions and high frequency resistance were thoroughly tested. Critical infrastructure systems had been selected, compiled and lab-tested in conjunction with the project work packages as early as mid of 2012. In the months prior to the measuring campaign, the working groups came up with scenarios that defined the measuring procedures as well as the infrastructure for the systems under test, the high frequency sources and measurement data recording. The basic safety procedures were determined; a frequency plan including the general conditions to be observed was negotiated with the Norwegian telecommunications authority.

The logistics for the technical preparation of the measuring campaign were very complex as a fully equipped measuring station had to be moved to a non-EU destination abroad. The Defence Science Institute for Protective Technologies – ABC-Protection (WIS) in Muster, Lower Saxony, also participated in the NATO measuring campaign and transported Fraunhofer INT's measuring booth plus its equipment to Norway on an additional trailer.

On the second to last weekend in August, Achim Taenzer (EME), Sven Ruge (WTI) and Michael Jöster (EME) embarked on their



Site of the first NATO STO SCI-250 measuring campaign: Ostoya Island off the coast of Horten, Norway.

http://commons.wikimedia.org/wiki/File:Oslofjord.svg

http://www.openstreetmap.de/karte.html#

journey to Norway in a company car. The following Monday, the WIS team also made it to the island and the Fraunhofer INT measuring booth was set up in the planned spot outside an unoccupied building.

The critical infrastructure test systems were set up during the first half of the week from August 26 – 30 and started up. Fraunhofer INT contributed a burglar alarm system, two smartphones, the INT-HPM detector, which was going to be a special test object to check the performance, and typical office computer network components. the Norwegian institute FFI, provided most of the equipment – computers, printers, monitors and interconnection cabling. High frequency resistant video cameras from Fraunhofer INT made it possible to monitor the test systems and the scenarios taking place in front of the building. A data recording system, provided by the Danish partner, was located in two construction trailers approximately in the middle between the measuring stations, networked all measuring control units with each other using special high frequency resistant technology. The data from the test network in the building and the video data streams was consolidated in the Fraunhofer INT measuring booth. It was fed into the Danish system for data recording. In the second half of the week, the HIPOW measurements were conducted in front of and inside of this building using non-military high frequency sources, including the Fraunhofer INT pulse sources.

The "NATO STO SCI-250" measuring campaign began in early September. The first week was dedicated to scientific work. Detailed data for the defined scenarios have been collected. After an initial analysis, the parameters and set-ups were altered to obtain further insights. Tests were now performed at two island locations. The basically identical scenarios were mainly tested inside and in front of the building, where the HIPOW measurements had previously been conducted. Over the course of the week, more computers that had been provided by the NATO Cooperation Support Office (CSO) in Paris, arrived and were integrated into the network. NATO working group partners set up so-called improvised explosive devices (IEDs) at a slight distance from the building alongside the access road and conducted tests with high frequency sources.

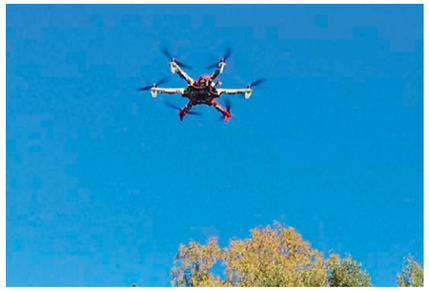
At the second measuring site with a large concrete slab covered space in the open terrain, WIS staff had been conducting tests on small unmanned aerial vehicles (UAVs) since the HIPOW week. A German defence company had accepted the invitation of the NATO working group to perform car-stopping demonstrations on the visitors' day and arrived at the end of the first test week for preparations. The guests brought car stopper systems in the form of an SUV, trailer and portable high frequency source. Given the proximity to the water, they also brought a speedboat on yet another trailer. The working group chairman had been generating a lot of interest in the project at NATO Headquarters ahead of time, which resulted in the announcement that a professional video would be filmed for the NATO YouTube channel. Footage was shot on Friday during the first NATO test week and the result may be viewed at http://www.youtube.com/watch?v=56veH8-KbEM. Most of the footage focuses on the stopping of cars and the manipulation of small aircraft since this worked best with the story the journalist wanted to report on.

During the final week, the emphasis was on the preparations for the visitors' day – Thursday. The main objective was to create a failure setting that could be reproduced reliably for the individual scenarios based on the insights gained during the previous week. Hence, the scenarios to be demonstrated for the guests were now prepared accordingly. In the first scene, the Fraunhofer INT pulse source, which was set up in the road in front of the building, had to trigger the burglar alarm system in the building. Next, an HPM pulse source sitting on a flat-bed truck was to pass by and cause the failure of as many computers as possible in the building's network. In the following round, the goal was to make this computer network fail again and to even destroy some of the devices by placing a suitcase in the room that contained a pulse source. After switching locations, lamps in the set up IEDs indicated an ignition as the pulse source on the flat-bed truck passed the location. This section of the road was also used as the driving route on which a moving test vehicle is brought to a standstill by a passing car stopper vehicle. At a different measuring location, the pulse source in suitcase format was to manipulate remote controlled UAVs to perform unusual flight manoeuvers, including crashes. Moreover, engines of parked test cars and the speedboat were to fail with the stationary installed car stopper system.

The guests, with the NATO Chief Scientist at the helm, were welcomed in a large room in a building on the measuring venue with the outdoor area. Chairs for the guests had been set up and two large video images had been projected on one of the walls. The event began with presentations explaining the mission of "NATO STO SCI-250."

For the entire three previous weeks, the weather had been nice, stable and warm. However, on the visitors' day, heavy rain interfered with the planned presentations almost from start to finish and improvisation was the only option. Processes that included on location demonstrations were changed ad-hoc. Some of the tests could not be reproduced because of the rain, while the specifics of others did not go as planned. The sun did come out towards the end of the planned programme and a final tour gave all participants the opportunity to see and have the scenarios explained to them in detail. Ultimately, the event still allowed the researchers to demonstrate their work successfully and the objective to make the guests more aware of the potential dangers of electromagnetic attacks was attained.

Departure preparations already began that same evening. On Friday, the Fraunhofer INT measuring booth was loaded on the trailer and the teams embarked on their journeys home. Once they returned to the Institute, they remained busy for weeks unloading and reorganising, reviewing the data and documents. Given the data volume, the analytical and reporting work was still ongoing in early 2014.



BUSINESS UNIT “NUCLEAR EFFECTS IN ELECTRONICS AND OPTICS“

Dr. Stefan Metzger

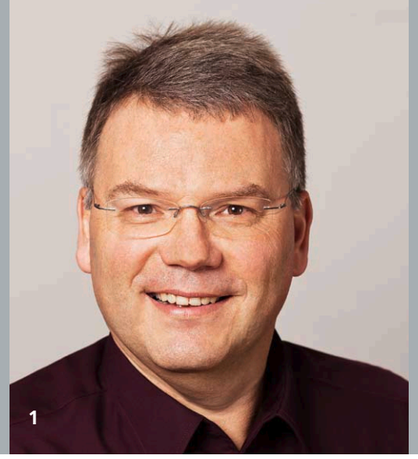
Fraunhofer INT’s Business Unit NEO specializes in the effects of ionizing radiation on electronic, optoelectronic and optical components and systems, on which it performs radiation tests to recognized standards. It also advises industry on radiation qualification and curing, for example for satellites or accelerators. Lessons learned are also used in the development of radiation sensors. Radiation tests are mainly carried out in INT’s own facilities, although external radiation facilities are used as well. It therefore features facilities for irradiation – unique in Europe – to recreate in the laboratory all relevant types of radiation, for satellites for example, and the effects they induce. In addition, the Business Unit has the latest technology available to measure even the smallest changes in parameter characteristics.

The well-established cooperation between NEO and the European Nuclear Research Centre (CERN) was intensified in the past year. Whereas in earlier years radiation tests were exclusively performed on optical fibres, NEO meanwhile also examines the effect on electronic components and systems and materials for CERN. These experiments were carried out both at home on NEO’s own Co-60 irradiation facilities, as well as on external high-dose irradiation facilities. P-channel field effect transistors radiation dosimeters (RadFET) were also calibrated in INT. These sensors are used in large numbers in the Large Hadron Collider (LHC) tunnel, to monitor the radiation dose locally. INT is best equipped for the task, since dose measurement using its own irradiation facilities is excellent, and it is also capable of measuring the smallest electrical signals over long distances with minimal error. It was thus possible to increase calibration accuracy by about one order of magnitude. The expansion of cooperation with CERN is discussed again in detail elsewhere in this Annual Report.

The commissioning of a cryostat to perform irradiation tests at very low temperatures represents a significant expansion of testing capabilities at NEO. For specific space missions in the field of high-energy accelerators, but also in fusion reactors, optical or electronic components are exposed to ionizing radiation, with the temperature in part reaching only a few Kelvin, i. e. close to absolute zero. Physical effects cause the impact of radiation on sample properties to increase considerably, so that a component can be completely unusable, in spite of withstanding the same radiation dose at room temperature. First results of the irradiation of optical fibres at 70 Kelvin (equivalent to about – 200° C) show an extreme rise in the reduction gain, so that light transmission would be impossible even over short distances.

NEO was also involved with two contributions and its own stand at the only European Radiation Effects Conference “Radiation Effects in Components and Systems“ (RADECS) in September 2013 in Oxford. At that venue, the RADECS Steering Committee accepted the official joint application by OHB, Bremen, Airbus Defence & Space, Bremen, and Fraunhofer INT, to mount RADECS 2016 in Bremen. INT will take over the scientific management (“Technical Chair”).

The 4th Workshop “Space Challenge“ took place at Fraunhofer INT In November 2013. More than 30 participants from the German aerospace industry, research institutes and the German Aerospace Centre (DLR) met to exchange information on radiation effects in space. As in previous years, the talks were in the main given by Business Unit staff. In addition, radiation experiments using INT facilities were shown to the participants. These included demonstrations on neutron-induced bit flips in static memories, increase in light attenuation in an optical fibre by gamma radiation and the shift of the input characteristic of a field effect transistor as a result of exposure to ionizing radiation. Experience shows that this type of workshop is very suitable for project planning. Following this event, the German Aerospace Centre DLR was even won as a new customer for the Business Unit Nuclear Security Policy and Detection Techniques (NSD). The participant survey shows a steady improvement in the quality of the workshop. The next is scheduled for November 2015.



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COOPERATION WITH CERN

Dipl.-Ing. Simone Schmitz, Thomas Loosen, M.Sc.

NEO put in tenders for several European Space Agency calls. Meanwhile, two have been accepted and are being processed in 2014. Among them is the evaluation of the future GSI accelerator FAIR (Facility for Antiproton and Ion Research) for the simulation of space radiation for applications in biology, material research, electronics, and detector development.

Following the overwhelming response provoked by the Business Unit's call for cooperation in a Fraunhofer Space Alliance, all rele-vant start-up preliminaries were dealt with under NEO leadership in 2013. Rules of procedure and a concept paper were written, and these documents were approved by the Board of the Fraunhofer-Gesellschaft in December 2013. Thus, nothing stood in the way of launching the Fraunhofer Space Alliance, with a total of 13 Fraunhofer Institutes participating. The representatives of the participating institutes unanimously elected INT Director Professor Lauster spokesman for the Alliance, and also agreed to establish the Alliance office at Fraunhofer INT.

Since both the Fraunhofer-Gesellschaft and INT have dedicated themselves to the promotion of young scientists, NEO is also involved in their training and education. In consequence, and in cooperation with the RheinAhrCampus of Koblenz University, a practical project and subsequent degree thesis on expanding the LaserSEE test site, as well as a Master's thesis for the Monte Carlo simulation of the new 450 kV X-ray irradiation facility in the Business Unit were both successfully completed (see separate posts in this Annual Report).

1 *Dr. Stefan Metzger*

Considering its cooperation with CERN, the Geneva nuclear research institute, 2013 was a particularly intensive year for INT's Business Unit NEO – Nuclear Effects in Electronics and Optics. Joint work began much earlier: already in 2004 glass fibres were first irradiated at INT to qualify them for use in the Large Hadron Collider (LHC), the big accelerator ring at CERN. The 2005 INT Annual Report carried the first article on radiation hardened glass fibres for the LHC.

Then as now, the irradiation tests shared the same background: very strong radiation occurs when the accelerator ring is in operation, including Gamma radiation doses of 10 MGy over several weeks. These can damage or even make completely useless such opto-electronic components as those based on glass fibres ... components needed for complex control electronics. Depending on the manufacturer or the specific material of the fibre, radiation sensitivity levels vary. Some fibres survive the accelerator for several years, others become useless after a few weeks. Through tests carried out far in advance of LHC commissioning, it was possible to identify fibres that can survive in the LHC for very long. With these tests, INT was able to make a small but important contribution to the commissioning of the accelerator.

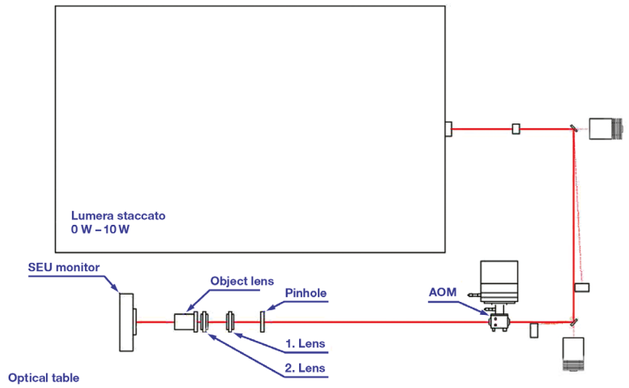
Cooperation was further intensified in the spring of 2012. A project on the calibration of RadFETs was launched in May. RadFETs are radiation-sensitive semiconductors that can be used for measuring the radiation dose, and they play an important role in internal radiation measuring at CERN. The project, concluded in December 2012, led to a large number of follow-up assignments.

Since then, CERN has had repeated demand for a very large number of highly-varied irradiation tasks. INT has tested a wide variety of components that need to function reliably under irradiation in the LHC, from the glass fibres mentioned, to the emergency lamps in the LHC's underground tunnel. At times, up to 30 different tests are being conducted concurrently at INT and at locations used by INT. For better and smoother cooperation in the future, an agreement between the two research bodies was concluded in 2013, regulating cooperation until 2016.

In addition to the actual qualification work, there has been considerable scientific output in the form of publications by CERN and INT. At the renowned RADECS Conference in Oxford in 2013, one paper and two posters were presented. Following this were a conference presentation and a poster at the Cyclotrons '13 Conference in Seattle. CERN is also sponsoring a PhD student, who is writing a doctorate on radiation dosimetry on fibre optic cables.

BACHELOR- AND MASTERTHESES

Raphael Wolf, B. Sc., Cedric Unger, M. Sc.



Construction of a laser system for the study of radiation-induced effects on single particles in semiconductor devices

The susceptibility of electronic semiconductor components to ionizing radiation has been known for decades. Already in 1962 a study was carried out which addressed cosmic radiation as a limiting factor for the integration of non-redundant electronic systems. From this it appears that the probability of impairment is 1 if the dimension of the sensitive elements is less than 10 µm. Comparing this structure with currently used sizes of less than 32 nm, the relevance of corresponding tests becomes apparent. A functional impairment such as is described here may already be caused by a single charged particle, a so-called „single-event effect". To create heavy ions with energies in the range of cosmic rays, accelerator facilities such as synchrotrons have to be used. However, since such systems have various disadvantages, such as the high irradiation costs, there is a desire for an inexpensive, easier-to-handle test method for single-event effects. As well as a heavy ion, a high-energy laser pulse can be used for the localized generation of charge carriers. For this reason, a laser system for irradiating semiconductor components was set up as an alternative.

The complete laser system set-up is shown in Figure 1. The picosecond laser used produces 9 ps-long laser pulses at a repetition rate of 40 kHz. At the end of the optical set-up, i.e. at the site of irradiation, the pulse energy is 500 pJ. Since no single shot operation is possible with this laser, a circuit had to be developed which controls the acousto-optic modulator (AOM) mounted in the beam path. Using this component, it is now possible to „cut" a single high-energy laser pulse at the press of a button. This laser pulse is then widened by a lens system and also focused through a lens. With this very small focal spot a single-event-effect can be triggered in the semiconductor component.

Author: Raphael Wolf, B. Sc.

Monte Carlo Simulation of X-Ray Tube by means of Geant4

INT's irradiation facilities include a 450kV X-ray tube, used for performing radiation treatments that serve the study of radiation effects on optical, electronic and optoelectronic components. The focus is on the quantification of the dose or the dose rate which has been deposited in the respective component.

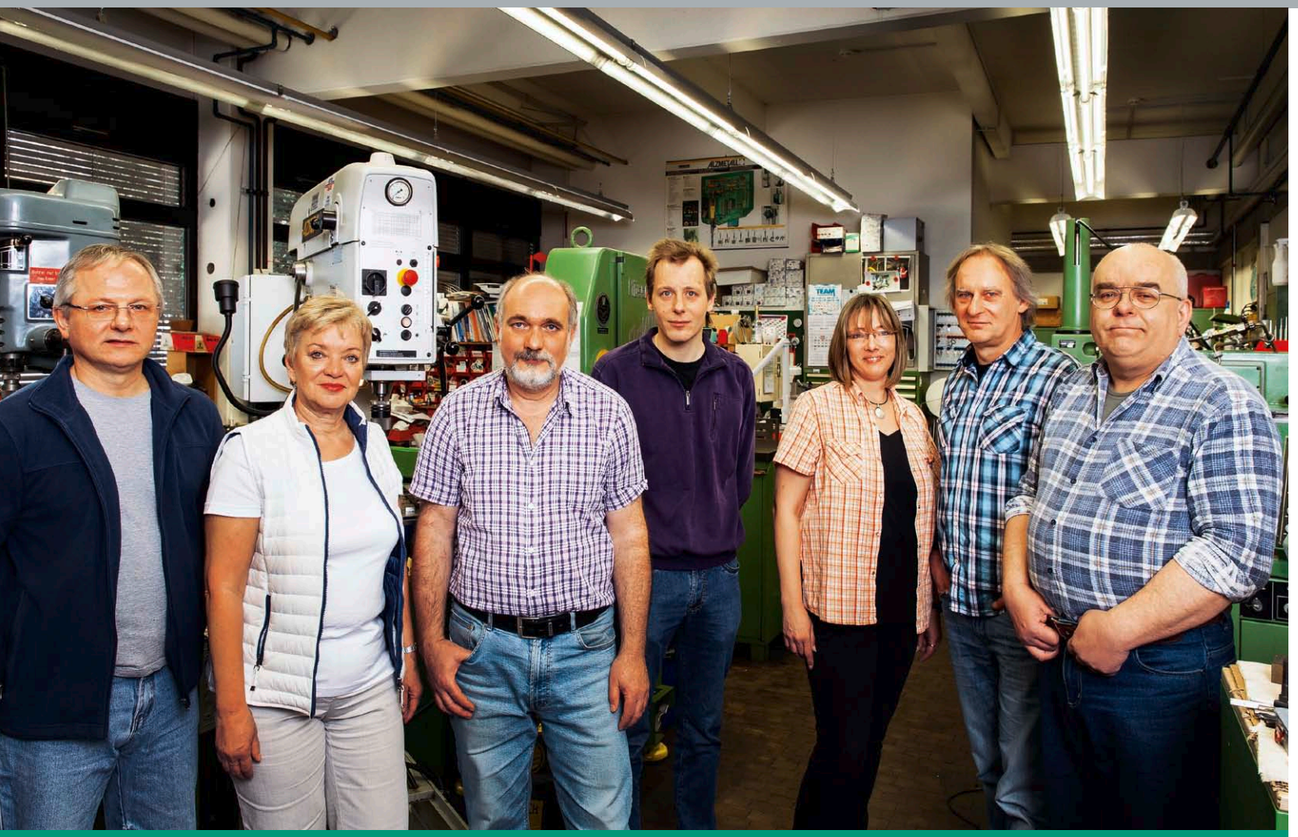
However, within an experiment or test set-up, it is not possible to determine the desired parameter, as no suitable measuring instrument is available or measured results cannot be easily transferred to certain components. To counteract this problem a simulation using the Monte Carlo toolkit Geant4 has been assembled (based on C++), which focuses on the calculation of dose deposits.

To this end, the tube was geometrically reconstructed within the programme, with the function of the x-ray tube being divided in two sub-programmes. In one sub-section the pure X-ray photon spectrum is generated for an applied tube voltage, so that this spectrum can be fed into the other sub programme in the tubing geometry.

As a first test for simulation implementation, a spatial dose rate measurement was performed using an ionization chamber, and applied in the simulation for comparison.

Author: Cedric Unger, M. Sc.

SCIENTIFIC-TECHNICAL SUPPORT



The Department Nuclear and Electromagnetic Effects (NE), has an extensive scientific-technical infrastructure that supports experimental work in its three Business Units. Belonging to this infrastructure is a precision engineering laboratory which makes special mechanical parts for experimental apparatus, and an electronics laboratory which produces specific electronics for experiment work and carries out servicing and repairs.

The Department also has its own secretariat. The following is a selective overview of the tasks performed:

Precision-engineering laboratory:

- Constructing and adjusting special apparatus for experiments
- Special mountings and fastenings for irradiation work (including sample boxes for CERN)
- Constructing special antennas and casings
- Supporting the installation of new irradiation facilities
- Coax-DC switches, directional couplers
- Preparing platforms for presentations

Electronics laboratory:

- Providing extensive support for all fields in preparing and conducting experimental work
- Consulting in the planning of INT's new buildings
- Developing irradiation and measuring boards
- Servicing and operating the neutron generators for irradiation projects
- Preparing and supporting measurements of CO_2 soil content (ANSTO Project)
- Operating the measuring computer network
- Cooperating on the installation of new irradiation facilities
- Electronics for safety systems (radiation protection interlock)
- Work safety, fire protection and office technology
- Hosting 4 scientific assistants
- Hosting 4 school-age trainees (from 1 to 3 weeks)

Secretariat:

- Formatting and producing posters
- Providing organizational support for projects
- Formatting study reports, radiation protection documentation
- Preparing and drafting EU project applications (e.g. Framework Programme 7)
- Preparing and hosting workshops

BUSINESS ADMINISTRATION AND CENTRAL SERVICES

Prof. Dr. Harald Wirtz

Business Administration and Central Services is the department responsible for all commercial and administrative tasks in the Institute. As well as providing the central infrastructure, department staff also carries out employer duties such as workplace safety and security.

The Department subdivides into Finance, Human Resources and Law (FPR), and Central Infrastructure (ZI). In addition, the sectors Library, Security, Marketing, and PR operate independently.

Finance, Human Resources and Law

The group Finance, Human Resources and Law is responsible for book-keeping, accounting, controlling, human resources and travel management.

Book-keeping is conducted in accordance with German commercial and tax law. Current transactions are simultaneously entered in finance and cost accounts to make cost data available for both internal accounting and controlling. The area also handles the purchase of all consumer items and investment goods, in compliance with purchase guidelines and the official German terms for awarding service and construction contracts (VOL / VOB). In cooperation with the Fraunhofer Gesellschaft HQ in Munich, invitations for major procurement tenders are publicized throughout Europe. The department also manages the INT cash office, handling all cash and non-cash payments.

Controlling's task covers all monetary processes within Fraunhofer INT, which includes the continuous supervision and control of the Institute's entire budget. To this end, the department evaluates cost and performance accounts as well as the finance accounts, and produces monthly control data showing projections on a cost and payment basis. There is also administrative support for project budgets in other departments, involving help in drafting quotations and applications, calculating, concluding contracts and budget supervision. Since sponsors continuously conduct internal and external audits of the Institute, the department also deals with all audit inquiries.

Human Resources supports the Institute's management in personnel planning, and processes all personnel tasks such as job advertising, hiring, job evaluations and resultant income-group classification, as well as contract extenuation. In addition to general administrative duties such as personnel file and data management, HR supports INT departments in selection procedures, providing references and other services. Staff members are also given advice on all questions of labor and pay law.

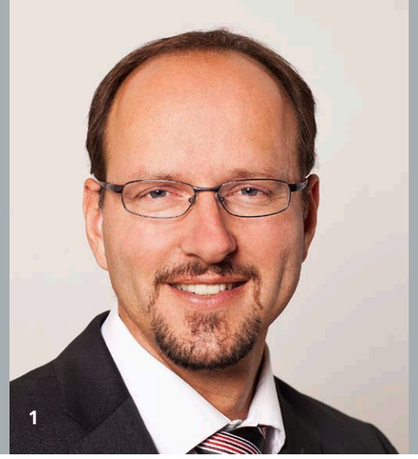
Travel management assists staff on every aspect of official travel, covering planning and preparation, transport and hotel bookings, and travel expense accounting in accordance with Federal Law.

Central Infrastructure

Central Infrastructure is responsible for Facility Management / Internal Services and Central IT Services.

Tasks include registering and organizing necessary repairs, coordinating user interests in construction work, equipment administration, managing and maintaining the vehicle fleet, procuring and managing furniture and office material, organizing office cleaning and operating the INT printing office. Another important activity was advising and supporting the heads of both administration and Institute, in advance of the construction work on INT's premises.

The Central IT Services operate the institutes IT-Infrastructure. This includes First-Level-Support for all Institute staff.



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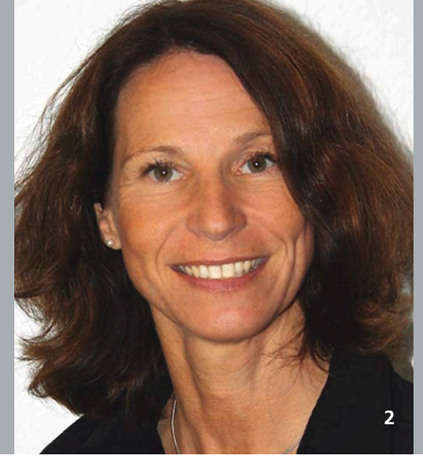

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Marketing and Public Relations

This section does all the necessary communications and marketing work for results produced by INT's various business units. In addition to brochures, exhibition stands and the Institute's web presence, this includes the Annual Report. Added to this is internal communication. All activities here are closely coordinated with the scientists concerned.

Library and Specialized Information Services

The predominant task here is procuring and managing the media required by the Institute, and supporting the scientists in their research work and information accessing. Depending on project needs, additional specialized databases and other information sources are licensed and made available. The staff is also given in-depth advice, support and training in the use of these sources. Furthermore, the Institute's publication processes enjoy full support, providing the optimal communication form for research results. Furthermore, the Library is training specialised personnel for information and documentation services.

Security and Secrecy

Information is a critical resource in an organization. Protecting information from unauthorized access, change or loss is more important than ever – especially in a facility concerned with security and defence research. This section supports information security management and the implementation and maintenance of secrecy regulations.

1 *Prof. Dr. Harald Wirtz*

Staff position Methods and Training

A staff position Methods and Training has been established in support of the Institute Director. Its task is to further develop the institute's spectrum of methods for technology analyses. Furthermore, the staff position is coordinating the activities of the chair „Technologyanalyses and -forecasts in the field of security Research".

In particular, the staff positions tasks include:

Support of the Institute Director regarding:

- Supervising the Institute's scientific cooperations
- Conducting the Institute Director's scientific projects
- Giving scientific advice to the Institute Director

LTVS@RWTH Aachen

Support of the chairholder „Technologyanalyses and -forecasts in the field of security Research" at the RWTH Aachen regarding:

- Developing and continually readjusting of the curriculae for teaching and research
- Guidance and training of the chairs scientific personnel
- Research in the fields of scientific futures research, technology forecasting and theory of science; focus on the development / advancement of methods

Further information at:
http://www.maschinenbau.rwth-aachen.de/go/id/fkop
http://ltvs.rwth-aachen.de/index.html

Competence Center „Methods and Training"

The competence centers tasks include:

- Development, adjustment and continuous improvement of methods of futures research needed at the Institute
- Consultancy, execution, accompaniment and evaluation of practical applications of methods of technology forecasting
- Development and execution of its own projects in this field
- Being a contact person for questions regarding this field

2 *Dr. Birgit Weimert*

FUTURE SECURITY 2013

The key players in German and European security research met again for the 2013 Future Security Conference. After taking place in Bonn the previous year, the 2013 conference moved back to the River Spree in Berlin. As in 2011, the venue this time was the Representation of North Rhine Westphalia in Berlin's Tiergarten, close to many ministries and federal agencies. This prestigious location was in part chosen to emphasize the dialogue between research and policy, which has been a primary aim of the conference since its inception. The conference took place from 17 to 19 September, 2013.

The conference is staged by the Fraunhofer-Verbund Verteidigungs- und Sicherheitsforschung VVS (Fraunhofer Group for Defense and Security), with a different group member being responsible for organizing each year. In 2013, Fraunhofer INT had the honour of preparing and conducting the conference for the first time.

Conference topics included Crisis Management and Electromagnetic Threats. Research into crisis management looks into responses to natural or man-made crises. Dealing with these crises is extremely complex. Firstly, there are many different cultures and technologies in rescue work, for example how the federal German states and the other European nations cope with crises. This can lead to coordination problems. Secondly, an appropriate response is often hindered by infrastructure failure, such as with communications and / or power grids or traffic routes. Modern crisis management attempts to circumvent these obstacles effectively.

With advances in networking and the increasing importance of electronic devices in all areas of life, the destructive use of electromagnetic radiation is a growing danger. Interference or damage by electromagnetic radiation can affect most electronic systems. This includes alarm systems and surveillance cameras, but also larger critical infrastructures at airports or the power grid. The study of electromagnetic threats and appropriate protective measures is therefore something of increasing future importance.

The Conference Dinner was held this year in a disused waterworks of the Berlin Water Utility. With the protection of complex, critical infrastructures being one of the most important safety research issues for a number of years, the water supply for a city of millions is a good example. The meticulously restored historic waterworks was a fitting backdrop for the evening's festive event.

For Prof. Dr. Michael Lauster, Director of the Fraunhofer Institute for Technological Trend Analysis INT and this year's Conference Chairman, the exchange between specialists was much in the foreground – in security more so than in other fields of research: "Future Security provides a unique platform for researchers, users and providers from within and outside Europe for the exchange of new ideas and research results".

Two ministries are patrons of the conference: the Bundesministerium für Bildung und Forschung BMBF (Federal Ministry of Education and Research) and the Bundesministerium für Verteidigung BMVg (Federal Ministry of Defence). Security research is also part of the German government's high tech strategy.

With 239 participants from 19 countries and an international share of 27 % in 2013, the Future Security Conference is now a recognized event, nationally and internationally.

SHORT NOTES

Festkolloquium

To celebrate the change at the head of the Institute, a formal celebration took place at Ameron Parkhotel, Euskirchen, on 21 March, 2013. After Prof. Dr. Dr. Michael Lauster had already succeeded his predecessor, Prof. Dr. Uwe Wiemken, in early September, 2012, the ceremony served as a festive setting for this important milestone in the Institute's history. For the occasion, the Institute was able to win a number of highly renowned speakers, who spoke on the scientific content of INT's three departments.

Prof. Dr. Dr. Axel Zweck, from the VDI Technology Centre, presented a talk on "Future Research – the State of the Art", Dr. Alois Sieber (past Director of IPSC in Ispra) addressed "The Protection of Critical Infrastructure from a European Perspective", and Willem Janssens (JRC ITU), spoke on "Nuclear Safeguards in Europe". Subsequently, Fraunhofer Board Member Prof. Dr. Ulrich Buller made the ceremonial handover. In his speech he paid tribute to Prof. Wiemken's great achievements for the Institute and wished his successor, Prof. Lauster, every success for the future. As Guest of Honour, the Institute welcomed the Mayor of Euskirchen, Dr. Uwe Friedl.

Nuclear Symposium

From 24 to 26 September, 2013, Fraunhofer INT hosted the symposium "Nuclear and Radiological Threats" for the 6th time. There was a total of 41 participants at the bi-annual event, coming in the main from government institutions and national non-government agencies. The International Atomic Energy Agency attended for the first time. The objective of the symposium series is to provide an overview of Germany's current scientific and technical capacity for assessing nuclear weapons and their risks, and to discuss the security policy implications.

Agenda topics ranged from the activities of several states in the field of nuclear weapons, the problems of nuclear proliferation and misuse of nuclear medicine materials through to analyses for detecting undeclared activities.

APPENDIX

University Courses

Chmel, S.: Vorlesung Physics im Bachelorstudiengang Naturwissenschaftliche Forensik (2. Semester) der Hochschule Bonn-Rhein-Sieg, SS 2013

Chmel, S.: VVorlesung und Übung „Measuring Techniques" im Bachelorstudiengang Naturwissenschaftliche Forensik (3. Semester) der Hochschule Bonn-Rhein-Sieg, WS 2013

Chmel, S.: Vorlesung "Physik I" im Bachelorstudiengang „Medizintechnik" der Fachhochschule Koblenz, Rhein-Ahr-Campus, WS 2013

Hecht-Veenhuis, S.: Wissenschaftliche Publikationen und Open Access: Der freie Zugang zu Wissen (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 29 2013

Heuer, C.: Human Performance Enhancement (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 13 2013

John, M.: Die Technisierung des Menschen – Über Cochlea Implantate, Cyborgs und Human Enhancement (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, June 17 2013

John, M.: Das Cochlea Implantat: Funktionsweise, Entwicklung, Chancen, Risiken und Erfahrungen im Hinblick auf die logopädische Praxis, IB-Medizinische Akademie, Schule für Logopädie, Berlin, August 8 2013, August 12 2013

John, M.: Rehabilitation von Versicherten mit Cochlea-Implantaten, Deutsche Rentenversicherung Bund (DRV), Berlin, October 30 2013

Jovanović, M.: Bibliometrie – Die Wissenschaft der Wissenschaft, Study programme (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 29 2013

Jovanović, M.: Projektmanagement, University of Düsseldorf, Düsseldorf, SS 2013

Jovanović, M.: Bibliometrische Analysen (AS II: Informetrie – Kurs 1), University of Düsseldorf, Düsseldorf, SS 2013

Lauster, M.: Methoden der Zukunftsforschung I, RWTH Aachen University, Faculty for Mechanical Engineering, Aachen, WS 2013 / 2014

Offenberg, D.: Climate Engineering – Plan C zur Rettung des Klimas, Study programme (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, June 6 2013

Thorleuchter, D.: Semantisches Textmining, Study programme (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 29 2013

Weimert, B.: Study programme, RWTH Aachen University, Aachen, WS 2013 / 2014

Wiemken, U.: Study programme (Bachelor's degree "Technikjournalismus / PR"), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, WS 2012/2013

Wiemken, U.: Vorlesung / Seminar Bachelor Studiengang Technikjournalismus, Modul „Technik und Fortschritt", Hochschule Bonn-Rhein-Sieg, Sankt Augustin, WS 2012 / 2013

Wiemken, U.: Study programme (Bachelor's degree "Technikjournalismus / PR" and Master's degree "Technik- und Innovationskommunikation), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, SS 2013

Wirtz, H.: Prozessmanagement – Change / Innovation, Fresenius University of Applied Science, Cologne, SS 2013

Wirtz; H.: Change- und Innovationsmanagement, Fresenius University of Applied Science, Cologne, WS 2013 / 2014

Wirtz, H.: Finanzierung, Fresenius University of Applied Science, Cologne, WS 2012 / 2013, SS 2013, WS 2013 / 2014

Wirtz, H.: Investitionsrechnung, Fresenius University of Applied Science, Cologne, WS 2012 / 2013, SS 2013, WS 2013 / 2014

International Cooperation

Berky, W., Chmel, S., Friedrich, H., Köble, T., Risse, M., Rosenstock, W., Schumann, O.: Cooperation with French partners on Project ANCHORS (UAV-Assisted Ad Hoc Networks for Crisis Management and Hostile Environment Sensing), May 2012 – April 2015

Berky, W., Chmel, S., Friedrich, H., Köble, T., Risse, M., Rosenstock, W., Schumann, O.: Cooperation with Ukrainian border agencies and the JRC (Ispra, Italy) on Project "Ukrainian border crossing station" (NSD), November 2008 – October 2014

Berky, W., Köble, T., Risse, M., Rosenstock, W.: Cooperation with the JRC (Ispra, Italy) on the Project ITRAP+10 (NSD)

Berky, W., Chmel, S., Friedrich, H., Köble, T., Risse, M., Rosenstock, W., Schumann, O.: Cooperation with 9 partners on the Project SCINTILLA (Scintillation Detectors and new Technologies for Nuclear Security), January 2012 – December 2014

Berky, W., Chmel, S., Friedrich, H., Köble, T., Risse, M., Rosenstock, W., Schumann, O.: Cooperation with 38 partners on the FP7 Project EDEN (End-user Driven Demo for CBRNE), September 2013 – August 2016

Burbiel, J., Schietke, R.: Coordination of FP7 Security Research Project ETCETERA (Evaluation of critical and emerging technologies for the elaboration of a security research agenda, cf. www.etcetera-Project.eu), 14 partners, October 2011 – November 2013

Chmel, S.; Köble, T.: Expert in FP7 Project BOOSTER (BiO-dOSimetric Tools for triagE to Responders)

Grigoleit, S., Blab, R.: Work package leader in FP7 Security Research Project ETTIS (European Security Trends and Threats in Society, cf. ettis-Project.eu), 10 partners, January 2012 – December 2014

Jovanović, M.: Member of Advisory Boards of INSEC (Increase Innovation and Research within Security Organizations)

Jovanović, M., Pinzger, B., Frech, I.: Cooperation in FP7 Project INNOSEC (Innovation Management Models for Security Organizations), 9 partners, February 2012 – January 2014

Köble, T.: Expert in FP7 Project ETCETERA

Lauster, M.: Beginning of Cooperation with ESA / ESTEC, Noordwijk, Netherlands

Metzger, S.: CERN, Geneva, Switzerland

Metzger, S.: European Space Agency – ESTEC, Noordwijk, Netherlands

Metzger, S.: Austrian Institute of Technology AIT – Seibersdorf Laboratories, Seibersdorf, Austria

Metzger, S.: Paul Scherrer Institute (PSI), Villigen, Switzerland

Römer, S., Schietke, R., Burbiel, J., Pinzger, B.: Coordination of Project SoBID (Stand-off Bio Detection) by order of EDA, cooperation with two Spanish partners Isdefe and Ibatech

Rosenstock, W.: Collaboration in the Working Group on Verification Technologies and Methodologies (VTM), organized by the Non Proliferation and Nuclear Safeguards Unit in the Joint Research Centre in Ispra, Italy, where verification (in general, not exclusively nuclear) is in permanent process for ESARDA (European Safeguards Research and Development Association)

Rosenstock, W.: Collaboration in the ESARDA Export Control Working Group (EXP-WG), regarding export of material as well as knowledge

Suhrke, M., Jöster, M., Adami, Ch.: Collaboration in the NATO STO SCI-250 Task Group Radio Frequency Directed Energy Weapons in Tactical Scenarios

- Meeting 2013: Dahlgren, Virginia, USA, February 5 – 7 2013, Euskirchen, March 13 – 15 2013, Prague, Czech Republic, June 18 – 20 2013, Copenhagen, Denmark, December 3 – 5 2013;
- Measuring campaign DEAR (Directed Energy At Radio Frequencies): Horten, Norway, August 26 – 13 September 2013;
- Meeting Subgroup NATO HPM Standardization: Euskirchen, March 14 2013, November 12 –13 2013

Suwelack, K.-U., Grigoleit, S., Blab, R.: Collaboration in the FP7 Security Research Project D-BOX (Comprehensive Toolbox for Humanitarian Clearing of Large Civil Areas from Anti-Personal Landmines and Cluster Munitions, cf. www.d-boxproject.eu), 20 partners, January 2013 – December 2015

International Reviews

Burbiel, J.: Letters in Drug Design & Discovery

Höffgen, S.: Photonics Technology Letters (IEEE), NEO: RADECS Conference

Jovanović, M.: Reviewer for "Scientometrics"

Kuhnhenn, J.: Optics Letters (OSA - The Optical Society)

Kuhnhenn, J.: Applied Physics B: Lasers and Optics (Springer)

Kuhnhenn, J.: Transactions on Nuclear Science (IEEE)

Kuhnhenn, J.: Nuclear Instruments and Methods in Physics Research Section A (Elsevier)

Kuhnhenn, J.: Journal of Lightwave Technology (IEEE/OSA)

Lauster, M.: Member of the Program Committee of the 8th Future Security Research Conference

Lubkowski, G.: Progress in Electromagnetic Research

Suhrke, M.: IEEE Transactions on Electromagnetic Compatibility

Thorleuchter, D.: Technological Forecasting and Social Change

Thorleuchter, D.: Electronic Commerce Research and Applications

Thorleuchter, D.: International Journal of Information Science

Thorleuchter, D.: Journal of Advanced Computer Science & Technology

Thorleuchter, D.: International Journal of Advanced Robotic Systems

Thorleuchter, D.: Information Sciences

Collaboration in Committees

Burbiel, J.: Ethical Advisory Board of the EDEN Project

Chmel, S.: Coordinator in the Working Group "Projektmanagement" of Fraunhofer EU-network

Gericke, W.: Active member in the Working Group of Security Officers of North-Rhine Westphalia (AKSIBENW)

Gericke, W.: Active member in the Working Group "Best Practice Handbuch für VS-NfD", supported by AK-SiBe-NRW, ASW, BSI, BMWi, Headquarter of the Fraunhofer-Gesellschaft (FhG)

Gericke, W.: Temporary speaker of AK-SiBe, FhG

Grüne, M.: Program Committee, Future Security, 8th Security Research Conference, Berlin

Hecht-Veenhuis, S.: Subcommittee of Berufsbildungsausschuss NRW "Geprüfter Fachwirt / Geprüfte Fachwirtin für Medien- und Informationsdienste in NRW"

Jovanović, M.: Program manager of Future Security (FuSec) 2013

Jovanović, M.: Member of Program Committee ISSI 2013

Jovanović, M.: Chairman (on behalf of) ISSI 2013 (Session C: Research Domain Studies)

Missoweit, M.: European Defence Agency, Point of Contacts Research & Technology, Brussels, Belgium

Missoweit, M.: Letter of Intent 6 EDIR / FA, Group of Research Directors Point of Contacts, Europe

Missoweit, M., Schulze, J.: EUROTECH Security Research Group, Europe

Römer, S., Burbiel, J.: Letter of Intent 6 EDIR / FA, Disruptive Technology Group

Rosenstock, W.: Collaboration in the Working Group on Verification Technologies and Methodologies (VTM), organized by the Non Proliferation and Nuclear Safeguards Unit in the Joint Research Centre in Ispra, Italy, where verification (in general, not exclusively nuclear) is in permanent process for ESARDA (European Safeguards Research and Development Association)

Thorleuchter, D.: Chairman of the Special Interest Group "Information- and Communication Systems" of the German Computer Society (Gesellschaft für Informatik e.V. (GI))

Thorleuchter, D.: Program Committee 2013 World Conference on Information Systems and Technologies (World CIST 2013), March 27 – 30 2013, Algarve, Portugal

Thorleuchter, D.: Program Committee 8th International Conference on Information Processing, Management and Intelligent Information Technology (ICIPT 2013), April 01 – 03 2014, Seoul, Korea

Thorleuchter, D.: Program Committee 9th International Conference on Computing Technology and Information Management (ICCM 2013), June 18 - 20 2013, Jeju Island, Korea

Thorleuchter, D.: Editorial Board of the International Journal of Digital Contents and Applications

Thorleuchter, D.: Editorial Board of the International Journal of Information Science

Thorleuchter, D.: Editorial Board of the Journal of Advanced Computer Science & Technology

Thorleuchter, D.: Editorial Board of the International Journal of Advanced Robotic Systems

Thorleuchter, D.: Editor of Lecture Notes in Information Technology (LNIT)

Weimert, B.: Election to the board of the Netzwerk Zukunfts-forschung e.V. (www.netzwerk-zukunftsforschung.eu)

Weimert, B.: Scientific editor for Zeitschrift für Zukunfts-forschung (www.zeitschrift-zukunftsforschung.de)

Participation in Norming Processes

Adami, Ch.: NA 140-00-19 AA
Writing VG-standards VG96900-96907, NEMP and Lightning Protection, Creation of the VG-standards on Equipment Limits

Adami, Ch.: NA 140-00-20-02UA
Creation of VG-standards VG95370 ff, Electromagnetic Compatibility

Adami, Ch.:
NATO HPM Standardization (NATO STO SCI-250 Task Group)

Jöster, M.: DKE / AK 767.13.5
"EMV von Halbleitern" (EMC of semiconductors), DKE Deutsche Kommission Elektrotechnik Elektronik Informations-technik im DIN und VDE (DKE German Commission for Electrical, Electronic & Information Technologies within DIN and VDE)

Köble, T.: DIN und VDE DKE / GUK 967.2
"Aktivitätsmessgeräte für den Strahlenschutz" (Acitivity measuring instruments for radiation protection)

Suhrke, M.:
National representative for the Joint Task Force Reverberation Chamber, IEC

Suhrke, M.: GAK 767.3/4.4
"TEM-Wellenleiter und Reverb-Chamber" (TEM waveguide and Reverb Chamber), DKE Deutsche Kommission Elektro-technik Elektronik Informationstechnik im DIN und VDE (DKE German Commission for Electrical, Electronic & Information Technologies within DIN and VDE)

Lectures and Presentations

Schulte, A.:
Light-trapping and Superhydrophobic Plant Surfaces – Optimized Multifunctional Biometic Surface for Solar Cells, Institute for Applied Physics, KIT, Karlsruhe, February 1 2012

Huppertz, G.:
Selection of Emerging Technologies with Security Implications in Time Frame 2020 to 2030, Etcetera WP5.3 Workshop, Frankfurt, February 13 - 14 2013

Lauster, M.:
"Botschaft der Forschung" Lecture at Forschung & Technologie-Strategiegruppe BMVg, Bonn, February 26 2013

Römer, S.:
Scenario approaches for assessing technologies and answering capability gaps, Trilateral meeting on Unmanned Systems, Den Haag, Netherlands, March 11 2013

Römer, S.:
Miniaturization in robotics and unmanned systems and platforms, Trilateral meeting on Unmanned Systems, Den Haag, Netherlands, March 12 2013

Thorleuchter, D.:
"Priorisierung im Rahmen der Rüstungsabschirmung", Meeting of the AG Rüstungsabschirmung, Euskirchen, March 13 2013

Huppertz, G.:
Identification of emerging technologies with security implications: Experience and Results from the Project ETCETERA, 1st PACITA conference, Prague, Czech Republic, March 13 – 15 2013

Burbiel, J.; Bonfanti, M.:
Holistic technology assessment in security: The ethical dimensions of critical and emerging technologies, 1st PACITA project conference, Prague, Czech Republic, March 15 2013

Jovanović, M.:
Participant at panel debate for "Challenge the Best Conference", St. Gallen, Switzerland, March 18 2013

Reschke, S.:
Neural & Biological Soldier Enhancement – From SciFi to Deployment, EDA HuPE Workshop 1, TNO Soesterberg, March 19 – 20 2013

Wiemken, U.:
Aufgaben und Themenstellungen seit 1974 – Anmerkungen im Rückblick auf die letzten vierzig Jahre, Festkolloquium, Fraunhofer INT, Euskirchen, March 21 2013

Neupert, U.:
Die Wehrtechnische Vorausschau 2011+, Konzepte & Ergebnisse, Planungsamt Berlin, March 26 2013

Thorleuchter, D., Van den Poel, D.:
Analyzing Website Content for Improved R&T Collaboration Planning, World Conference on Information Systems and Technologies, Portugal, March 27 2013

Lauster, M.:
Trends und Entwicklungen in Forschung und Technologie, Key Note at Internationales Wirtschafts- und Transportforum, Bremerhaven, April 18 2013

Wiemken, U.:
Automatisierung und technische Autonomie – ethische Aspekte eines Drohneneinsatzes, Lecture series in Technik- und Umweltethik at the Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, SS 2013, April 18 2013

Gericke, W.:
Das sichere VS-Verwahrgelass, Lecture at T-Mobile, Bonn, April 24 2013

Lauster, M.:
Trends und Entwicklungen, Invited lecture at DWT-Veranstaltung in PlgA Bw, Berlin, June 17 2013

Lauster, M.:
Trends in Wissenschaft und Technik, Lecture at Forschung & Technologie-Informationstag in BAAINBw, Koblenz, June 19 2013

Lauster, M.:
Das Fraunhofer INT und seine Rolle im F&T-Prozess, Lecture at 11. EVI-Treffen, Wachtberg, June 21 2013

Grüne, M.:
Zukunftstechnologien für Landstreitkräfte – Ergebnisse der Wehrtechnischen Vorausschau (WTV), Symposium Landstreitkräfte (Sym LaSK), BMVg Plg I 3, Brühl, July 9 2013

Lauster, M.:
Innovative Trends, Keynote lecture at Informationsveranstaltung der IHK Aachen and Bonn-Rhine-Sieg, July 11 2013

Thorleuchter, D.: Semantic cross impact analysis, GFKl 2013 Annual Meeting, Luxembourg, July 11 2013

Reschke, S.:
Nichts ist unmöglich – Ein Blick in die Zukunft der Werkstoffentwicklung, 6. Clusterkonferenz of Innovationscluster Metall-Keramik-Kunststoffe, CeraTechCenter (CTC), Höhr-Grenzhausen, August 20 2013

Missoweit, M.:
Innovation in Crisis Management needs room for experimentation, 4rd Annual Virginia Tech Colloquium on Community Resilience, Davos, Switzerland, August 28 – 30 2013

Neupert, U.:
Zukunftstechnologien für Landstreitkräfte, results of Wehrtechnischen Vorausschau, WE-Treffen SKB, Bonn, September 3 2013

John, J.:
Bibliometric classification of emerging Topics, 18th International Conference on Science and Technology Indicators, Berlin, September 4 – 6 2013

Wiemken, U.:
Zur Geschichte der Dampfmaschine – eine Schlüsseltechnik der Industriellen Revolution, Rotary-Club Euskirchen-Burgfey, September 6 2013

Huppertz, G.:
Identification and Analysis of Emerging Technologies with Security Relevance: Results and Conclusions, Etcetera Final Workshop, Rome, Italy, September 8 – 10 2013

Huppertz, G.:
Identification of Emerging Technologies with Security Implications: Experience and Results from WP4 of the Project ETCETERA 8th Future Security 2013 research conference, Berlin, September 17 – 19 2013

Missoweit, M.:
Moderation of the Session Crisis Management, 8th Future Security 2013 research conference, Berlin, September 17 – 19 2013

Lauster, M.:
Neue Trends in Forschung und Technologie – Intelligenz in technischen Produkten, Invited lecture at AFCEA-Forum, Köln-Wahn, October 23 2013

Lauster, M.:
On Some Key Technologies of the 21st Century,
Invited lecture at National Academy of Sciences, Washington,
USA, October 28 2013

Kohlhoff, J.:
Technological implications for "Postfossile Bundeswehr",
Runder Tisch "Energie", BMVg, Bonn, November 6 2013

Neupert, U.:
Current technology trends and technology progresses
in alternative energy supply, Runder Tisch "Energie",
BMVg, Bonn, November 6 2013

Reschke, S., Valk, P., Heuer, C.:
Human Performance Enhancement – EDA project 12.R&T.RP.320,
CapTech Meeting ESM04, Brussels, November 6 – 7 2013

Lauster, M.:
Elektromobilität – Quo vadis?, Invited lecture at Forschungs-
dialog Rheinland of IHK Aachen, November 13 2013

Gericke, W.:
Strukturelle Darstellung des VS-NfD-Merkblatts, Lecture at
CISCO, Neuss, November 19 2013

Müller, M.:
Technologiefrühaufklärung by Fraunhofer INT
– Vom kontinuierlichen Monitoring zur vertieften Analyse,
DIFI-Forum "Technologiefrühaufklärung", Darmstadt,
November 21 2013

Wiemken, U.:
Technik und der Wandel in der Gesellschaft – Gesamtgesell-
schaftliche Aspekte der Verteidigungs- und Sicherheitsforschung,
2. Hamburger Impuls of IKZ, as guests at Führungsakademie
der Bundeswehr, Hamburg, November 21 2013

Burbiel, J.:
Präparative Kennzeichungstechnologien, Collective special
meeting AG Kripo / UA FEK at Fraunhofer IOSB, Karlsruhe,
November 22 2013

Missoweit, M.:
The Human Factor in Crisis Management
– An Experimental Approach, Berlin Security Conference,
Berlin, November 25 – 27 2013

Publications

Adami, C.; Braun, C.; Clemens, P.; Jöster, M.; Schmidt, H.-U.; Suhrke, M.; Taenzer, A.:
Detektion von Hochleistungsmikrowellen (Wehrtechnisches Symposium "Elektromagnetische Effekte" <2013, Mannheim>)
In: Bildungszentrum der Bundeswehr, Mannheim: Wehrtechnisches Symposium Elektromagnetische Effekte. CD-ROM: June 10 – 12 2013, Mannheim. Mannheim, 2013, pp. 21

Adami, C.; Braun, C.; Clemens, P.; Jöster, M.; Suhrke, M.; Schmidt, H.-U.; Taenzer, A.:
HPM detector system with frequency identification (Security Research Conference "Future Security" <8, 2013, Berlin>)
In: Lauster, M. (Ed.): 8th Future Security 2013. Security Research Conference: Berlin, September 17 – 19 2013. Proceedings. Stuttgart: Fraunhofer Verlag, 2013, pp. 322-328, URN urn:nbn:de:0011-n-2650001

Adami, C.; Jöster, M.; Schmidt, H.-U.; Suhrke, M.:
Ein HPM-Detektor mit Richtungserkennung
In: Bundesministerium der Verteidigung – BMVg –, Bonn: Wehrwissenschaftliche Forschung. Jahresbericht 2012: Wehrwissenschaftliche Forschung für deutsche Streitkräfte, Berlin: BMVg, 2013, pp. 34-35

Adami, C.; Braun, C.; Clemens, P.; Jöster, M.; Suhrke, M.; Taenzer, A.:
HPM-Verwundbarkeitsuntersuchungen von Komponenten kritischer Infrastrukturen (Wehrtechnisches Symposium "Elektromagnetische Effekte" <2013, Mannheim>)
In: Bildungszentrum der Bundeswehr, Mannheim: Wehrtechnisches Symposium Elektromagnetische Effekte. CD-ROM: June10 – 12 2013, Mannheim. Mannheim, 2013, pp. 24

Brandt, H.:
Silent speech interfaces
In: Europäische Sicherheit & Technik : ES & T, Vol. 62 (2013), No. 6, pp. 86

Burbiel, J.; Schietke, R.:
Results of the ETCETERA project (Security Research Conference "Future Security" <8, 2013, Berlin>)
In: Lauster, M. (Ed.): 8th Future Security 2013. Security Research Conference: Berlin, September 17 – 19 2013. Proceedings. Stuttgart: Fraunhofer Verlag, 2013, pp. 482-483, URN urn:nbn:de:0011-n-2650029

Burbiel, J.; Schietke, R.:
Final report. Deliverable 7.1, Euskirchen, 2013

Burbiel, J.; Schietke, R.:
Identification of emerging technologies and critical dependencies relevant to CBRN protection: Poster presented at 11th International Symposium on Protection against Chemical and Biological Warfare Agents 2013, June 3 – 5 2013, Stockholm, Sweden (International Symposium on Protection against Chemical and Biological Warfare Agents <11, 2013, Stockholm>), 2013, URN urn:nbn:de:0011-n-2759134

Burbiel, J.; Schietke, R.:
Recommendations for an emerging security technology research agenda (ESTRA): Deliverable D6.1
Euskirchen, 2013URN urn:nbn:de:0011-n-2817689

D'Haen, J.; Poel, D. van den; Thorleuchter, D.:
Predicting customer profitability during acquisition: Finding the optimal combination of data source and data mining technique
In: Expert Systems with Applications, Vol. 40 (2013), No. 6, pp. 2007-2012, DOI 10.1016/j.eswa.2012.10.023
URN urn:nbn:de:0011-n-2291534

Dönitz, E.; Shala, E.; Leimbach, T.; Bierwisch, A.; Grigoleit, S.; Klerx, J.:
D4.4 Catalogue of Threat Scenarios: Deliverable submitted in September, 2013 (M21) in fulfilment of the requirements of the FP7 project, ETTIS. European security trends and threats in society, Karlsruhe, 2013, URN urn:nbn:de:0011-n-2723445

Esmiller, B.; Curatella, F.; Kalousi, G.; Kelly, D.; Amato, F.; Haring, I.; Schäfer, J.; Ryzenko, J.; Banaszek, M.; Katzmarek, K. U.:
FP7 Integration Project D-Box ("Comprehensive Toolbox for Humanitarian Clearing of Large Civil Areas from Anti-Personal Landmines and Cluster Munitions) (International Symposium "Humanitarian Demining" <10, 2013, Sibenik>)
In: Jakopec, D.: 10th International Symposium "Humanitarian Demining 2013". Book of Papers: 23 – 25 April 2013, Sibenik, Croatia. Zagreb: HCR-CTRO, 2013, pp. 21-22, URN urn:nbn:de:0011-n-2800228

Euting, T.:
Physically Unclonable Functions,
In: Europäische Sicherheit & Technik : ES & T, Vol. 62 (2013), No.10, pp. 79

Fechtelkord, M.; Langner, R.:
Aluminum ordering and clustering in Al-rich synthetic phlogopite: The influence of fluorine investigated by {19F/1H} 29Si CPMAS NMR spectroscopy
In: American Mineralogist, Vol. 98 (2013), No. 1, pp.120-131, DOI 10.2138/am.2013.3885

Freudendahl, D.:
Künstliche Exoskelette
In: Europäische Sicherheit & Technik : ES & T, Vol. 62 (2013), No. 5, pp. 76

Freudendahl, D.; Langner, R.; Kohlhoff, J.; Reschke, S.:
Werkstofftrends: Biokunststoffe aus Polyhydroxyalkanoaten
In: Werkstoffe in der Fertigung, (2013), No. 2, pp. 3

Freudendahl, D.:
Biokunststoffe
In: 50 Jahre Werkstoffe in der Fertigung, (2013), No. 3, pp.12-13

Freudendahl, D.; Brandt, H.:
Mikrofluidiktechnologie
In: Europäische Sicherheit & Technik : ES & T, Vol. 62 (2013), No. 12, pp. 89

Freudendahl, D.; Langner, R.; Kohlhoff, J.; Reschke, S.:
Werkstofftrends: Biokunststoffe aus Polymilchsäure
In: Werkstoffe in der Fertigung, (2013), No. 5, pp. 3

Freudendahl, D.; Reschke, S.; Langner, R.; Kohlhoff, J.:
Werkstofftrends: Organische Photovoltaik
In: Werkstoffe in der Fertigung, (2013), No. 6, pp. 3

Friedrich, H.; Chmel, S.; Rosenstock, W.; Sannie, G.; Normand, S.; Peerani, P.; Tagziria, H.; Vita, R. de; Fanchini, E.; Firpo, G.; Botta, E.; Kovacs, A.; Lakosi, L.; Baumhauer, C.; Equios, M.; Petrossian, G.; Fosse, R.; Dermody, G.; Crossingham, G.:
SCINTILLA – scintillation detectors and new technologies for nuclear security (Security Research Conference "Future Security" <8, 2013, Berlin>)
In: Lauster, M. (Ed.): 8th Future Security 2013. Security Research Conference: Berlin, September 17 - 19 2013. Proceedings. Stuttgart: Fraunhofer Verlag, 2013, pp. 486-487, URN urn:nbn:de:0011-n-2650038

Girard, S.; Kuhnhenn, J.; Gusarov, A.; Brichard, B.; Uffelen, M. van; Ouerdane, Y.; Boukenter, A.; Marcandella, C.:
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Other Events

September 12 – 13 2013:
Gericke, W.: Meeting of AK-SiBe der FhG in Fraunhofer INT, Euskirchen

September 17 – 19 2013:
Lauster, M.: Chairman 8th Future Security Research Conference, Berlin

September 17 – 19 2013:
Frech, I.; Loosen, T.; Missoweit, M.: Organization 8th Future Security Conference, Berlin

September 24 – 26 2013:
6. Symposium Nukleare und radiologische Waffen – Technologische Urteilsfähigkeit und nukleare Sicherheit in Deutschland

September 26 2013:
Technology Briefing "Towards European Technological Independence" within the ETCETERA project, Brussels, Belgium, Responsible: Burbiel, J.

November 5 – 6 2013:
4th Workshop "Herausforderung Weltraum", Strahlungsanforderungen an Raumfahrtkomponenten, Fraunhofer INT, Euskirchen

Press Releases

March 12 2013:
Film for project CHORUS – ARD "Wissen vor Acht"

March 22 2013:
Smart Security Glass-Patent ist erteilt, Fraunhofer INT, Euskirchen

March 22 2013:
QM-Zertifizierung für Geschäftsfeld Nukleare Effekte in Elektronik und Optik, Fraunhofer INT, Euskirchen

September 11 2013:
Free field measuring campaign with the involvement of Fraunhofer INT in Norway: On Youtube NATOChannel.tv: http://www.youtube.com/watch?v=56veH8-KbEM und https://www.cso.nato.int/page.asp?ID=1382

September 16 2013:
Future Security 2013 (Rbb Inforadio, Presseerklärung)
Fraunhofer Gesellschaft, Press Release "Future Security 2013: Forschen für mehr Sicherheit", Chapter "Sicherheitslücken schließen: Angriffe auf elektronische Geräte"

December 2013:
Fraunhofer Forschung kompakt 12|2013:
dt.:"Elektromagnetische Angriffe abwehren",
en.: "Defending against electromagnetic attacks"
Press feedback: E & T Magazine, Physorg, sciencedaily.com, Before It's News, EE Times Europe, Elektronik Praxis, The Engineer, EDN Asia (Hongkong), Electronic Engineering Times Asia, RF Global Net, ExtremTtech, pro-physik.de, golem.de

APPENDIX

Institute Course

Dipl.-Volksw. Pastuszka , H.-M. (Fraunhofer INT Euskirchen):
Horizon 2020 – Zur Zukunft der Europäischen Sicherheits-forschung, Euskirchen, January 23 2013

Dr. Suhrke, M. (Fraunhofer INT Euskirchen):
Detektion von Hochleistungsmikrowellen, Euskirchen, February 6 2013

Dipl.-Ing. (TU), Dipl.-Wirt.-Ing. (FH) Kochsiek, J. (Fraunhofer IML Dortmund):
Entwicklungsperspektiven und Forschungsbedarf im Bereich Supply-Chain-Security, Euskirchen, February 20 2013

Dr. Freudendahl, D. (Fraunhofer INT Euskirchen):
Organoselenchemie, Euskirchen, March 6 2013

Dipl.-Math. Kieninger, M. (Fraunhofer IAIS Sankt Augustin):
Möglichkeiten der Bildverarbeitung im industriellen Umfeld und zur Erhöhung der Sicherheit in öffentlichen Räumen, Euskirchen, March 13 2013

Dr. Leonhardt, A. (IFW Dresden):
Synthese, Eigenschaften und Anwendung maßgeschneiderter Kohlenstoffnanoröhren, Euskirchen, March 20 2013

Dr. Brugger, M. (CERN)
Radiation to Electronics Challenges at the LHC, Euskirchen, April 4 2013

Dr. Schulte, A. J. (Fraunhofer INT Euskirchen):
Biomimetische Oberflächen: Lichtfangende, superhydrophobe Pflanzenoberflächen als Vorbilder für funktionale, technische Materialien, Euskirchen, April 17 2013

Dipl.-Ing. Reschke, S. (Fraunhofer INT Euskirchen):
Jomini von Clausewitz und das Strategische Technologie- und Innovationsmanagement, Euskirchen, April 24 2013

Prof. Dr.-Ing. Harig, R. (TU Hamburg-Harburg):
Ferndetektion von Gasen und Flüssigkeiten mit abbildender Spektroskopie: Von der Gefahrstoffdetektion im Zivilschutz bis zur Überwachung von Vulkanen, Euskirchen, May 8 2013

Prof. Dr. Wiemken, U. (Fraunhofer INT Euskirchen):
Die Rolle der Forschung bei Dual-Use-Technologien – Anmerkungen zu Theorie und Praxis, Euskirchen, May 15 2013

Dr. Brandt, H. (Fraunhofer INT Euskirchen):
Mineralogische Perspektiven auf die Endlagerung von Atommüll, Euskirchen, May 22 2013

Dr. Müller, M. (Fraunhofer INT Euskirchen):
OTFT-Sensoren, Euskirchen, June 5 2013

Dipl.-Phys. Kohlhoff, J. (Fraunhofer INT Euskirchen):
Schiffsantriebe auf dem Weg zur "Postfossilen Bundeswehr", Euskirchen, June 12 2013

Dr. Heuer, C. (Fraunhofer INT Euskirchen):
Nervensysteme wirbelloser Tiere – Anatomie, Phylogenie und Evolution, Euskirchen, September 4 2013

Dr. Schneider, R. (Universitätsklinikum Würzburg):
WHO REMPAN (Aufgaben, Funktion ...) REMPAN (Radiation Emergency Medical Preparedness and Assistance Network), Euskirchen, September 11 2013

Dipl.-Ing. Grypstra, K. (MPIfR Bonn):
Der Radiohimmel über Effelsberg, Euskirchen, October 2 2013

Dr.-Ing. Zepnik, S. (Fraunhofer UMSICHT Oberhausen):
Biobasierte Kunststoffe, Euskirchen, October 9 2013

Dr. Kretschmer, T. (Fraunhofer INT Euskirchen):
Von "Grenzen des Wachstums" bis "2052"
Vierzig Jahre Berichte und Prognosen des Club of Rome, Euskirchen, October 16 2013

Dr. Leonhardt, A. (IFW Dresden):
Synthese, Eigenschaften und Anwendung maßgeschneiderter Kohlenstoffnanoröhren, Euskirchen, November 13 2013

Dr. Eichhorn, M. (ISL):
Technologien für Hochleistungslaserquellen im augensicheren Spektralbereich, Euskirchen, November 20 2013

Dr. Ehlert, U. (NATO Brüssel):
Wissenschafts- und Technologiestrategie der NATO, Euskirchen, November 27 2013

Prof. Dr. Blume, A. (Universität Twente):
Innovationen im Elastomerbereich für Kraftfahrzeuge, Euskirchen, December 4 2013

Dr. John, M. (Fraunhofer INT Euskirchen): Bibliometrische Klassifizierung von Emerging Topics, Euskirchen, December 11 2013

Dr. Burbiel, J., Dr. Schietke, R. (Fraunhofer INT Euskirchen):
Das FP7 Project ETCETERA – Lessons identified, Euskirchen, December 18 2013

Patents

Patent DE102011003073: Security system for acquisition of break-in attempt on security glass

Awards

Ideenwettbewerb Netzwert 2013 of Fraunhofer Gesellschaft: 3rd place

BUSINESS UNITS AND CONTACTS

DIRECTOR‘S OFFICE

Director
Prof. Dr. Dr. Michael Lauster
Phone +49 2251 18-117/-217
Fax +49 2251 18-327
michael.lauster@int.fraunhofer.de

Vice-Director
Dr. Joachim Schulze
Phone +49 2251 18-303
joachim.schulze@int.fraunhofer.de

Commercial Director
Prof. Dr. Harald Wirtz
Phone +49 2251 18-237
harald.wirtz@int.fraunhofer.de

BUSINESS UNIT

DEFENSE TECHNOLOGY FORESIGHT

Dipl.-Volksw. Hans-Martin Pastuszka
Phone +49 2251 18-298
hans-martin.pastuszka@int.fraunhofer.de

Dr. Ulrik Neupert
Phone +49 2251 18-224
ulrik.neupert@int.fraunhofer.de

BUSINESS UNIT

CORPORATE TECHNOLOGY FORESIGHT

Dr. Martin Müller
Phone +49 2251 18-229
martin.mueller@int.fraunhofer.de

Dr.-Ing. Guido Huppertz
Phone +49 2251 18-325
guido.huppertz@int.fraunhofer.de

BUSINESS UNIT

PUBLIC RESEARCH AND TECHNOLOGY MANAGEMENT

Dr. Joachim Burbiel
Phone +49 2251 18-213
joachim.burbiel@int.fraunhofer.de

Dr. Silke Römer
Phone +49 2251 18-313
silke.roemer@int.fraunhofer.de

BUSINESS UNIT

TECHNOLOGY TRENDS AND STRATEGIES

Dr. Claudia Notthoff
Phone +49 2251 18-288
claudia.notthoff@int.fraunhofer.de

Dr. Anna Julia Schulte
Phone +49 2251 18-379
anna.schulte@int.fraunhofer.de

BUSINESS UNIT

INTERNATIONAL RESEARCH AND TECHNOLOGY MANAGEMENT

Dr. Merle Missoweit
Phone +49 2251 18-315
merle.missoweit@int.fraunhofer.de

Dr. Ruth Schietke
Phone +49 2251 18-245
ruth.schietke@int.fraunhofer.de

BUSINESS UNIT

NUCLEAR SECURITY POLICY AND DETECTION TECHNIQUES

Nuclear Threat and Risks including Terrorism; Scientific Aspects of Security Policy; State of Development and Misuse Potential of Nuclear Weapons; Evaluation of the Threat of Nuclear Weapons; Disarmament and Proliferation; Nuclear Verification with Nondestructive Measurement; Mobile Nuclear Measurement Systems; Neutron Spectroscopy; Active NeutronInterrogation; Environmental Radioactivity; Irradiation Protection

Dr. Wolfgang Rosenstock
Phone +49 2251 18-249
wolfgang.rosenstock@int.fraunhofer.de

Dr. Theo Köble
Phone +49 2251 18-271
theo.koeble@int.fraunhofer.de

BUSINESS UNIT

NUCLEAR EFFECTS IN ELECTRONICS AND OPTICS

Optical Fibers; Fiber-optic Dosimetry; Fiber-optic Components; Integrated Optics; Optical Communication and Sensor Systems; Semiconductor Components; Neutron Radiation; X-ray and Gamma Radiation; Proton Radiation; Dosimetry; Radiation Detection

Dr. Stefan Metzger
Phone +49 2251 18-214
stefan.metzger@int.fraunhofer.de

Dr. Jochen Kuhnhenn
Phone +49 2251 18-200
jochen.kuhnhenn@int.fraunhofer.de

Dr. Stefan Höffgen
Phone +49 2251 18-301
stefan.hoeffgen@int.fraunhofer.de

BUSINESS UNIT

ELECTROMAGNETIC EFFECTS AND THREATS

Electromagnetic Field Coupling; Electromagnetic Compatibility (EMC); Microwave Measurement Techniques; High-Power Microwaves (HPM); Electromagnetic Threats; High-Altitude Electromagnetic Pulse (HEMP)

Dr. Michael Suhrke
Phone +49 2251 18-302
michael.suhrke@int.fraunhofer.de

FURTHER CONTACTS

Marketing and Public Relations
Thomas Loosen, M. Sc.
Phone +49 2251 18-308
thomas.loosen@int.fraunhofer.de

Library and Specialized Information Services
Siegrid Hecht-Veenhuis
Phone +49 2251 18-233
siegrid.hecht-veenhuis@int.fraunhofer.de

Staff Position Methods and Training
Dr. Birgit Weimert
Phone +49 2251 18-307
birgit.weimert@int.fraunhofer.de

HOW TO REACH US

By road

Autobahn A1: leave at exit 110 “Euskirchen”; or
Autobahn A61: leave at exit 26 “Swisttal-Heimerzheim”

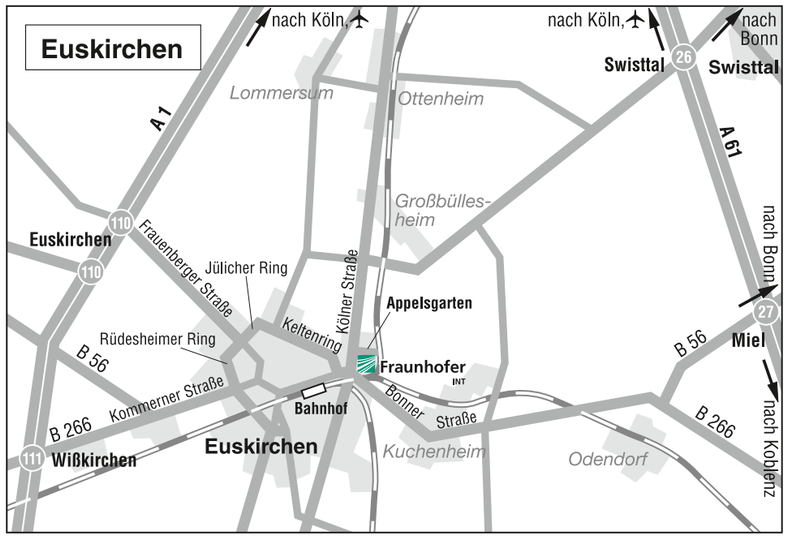
By air

Nearest airports:

- Cologne/Bonn (60 km)
- Düsseldorf (100 km)

By rail

Nearest Inter-City Main Stations:
Bonn Hauptbahnhof and Cologne Hauptbahnhof.
Regular rail connections between Bonn or Cologne Main Stations (Hauptbahnhof) and Euskirchen; from Euskirchen Station, Bus No 875 in direction “Großbüllesheim”; or Bus No 806 in direction “Fronhof” to “Appelsgarten”



**Fraunhofer Institute
for Technological Trend Analysis INT**

Appelsgarten 2
53879 Euskirchen

Phone +49 2251 18-0
Fax +49 2251 18-277

info@int.fraunhofer.de
www.int.fraunhofer.de

PUBLISHING DETAILS

Editors

Thomas Loosen, M. Sc. (responsible)
Silvia Weniger

Design, Realisation, Production

Konzeptbüro Horst Schneider, Erftstadt

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Michael Pasternak, Frankfurt
Ralph Hürten, Bad Münstereifel
Jens Kirchner, Düsseldorf
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Editor's Address

Fraunhofer-Gesellschaft
Presse- und Öffentlichkeitsarbeit
Appelsgarten 2
53879 Euskirchen

Phone +49 2251 18-0
Fax +49 2251 18-277

General inquiries via Email to:
thomas.loosen@int.fraunhofer.de