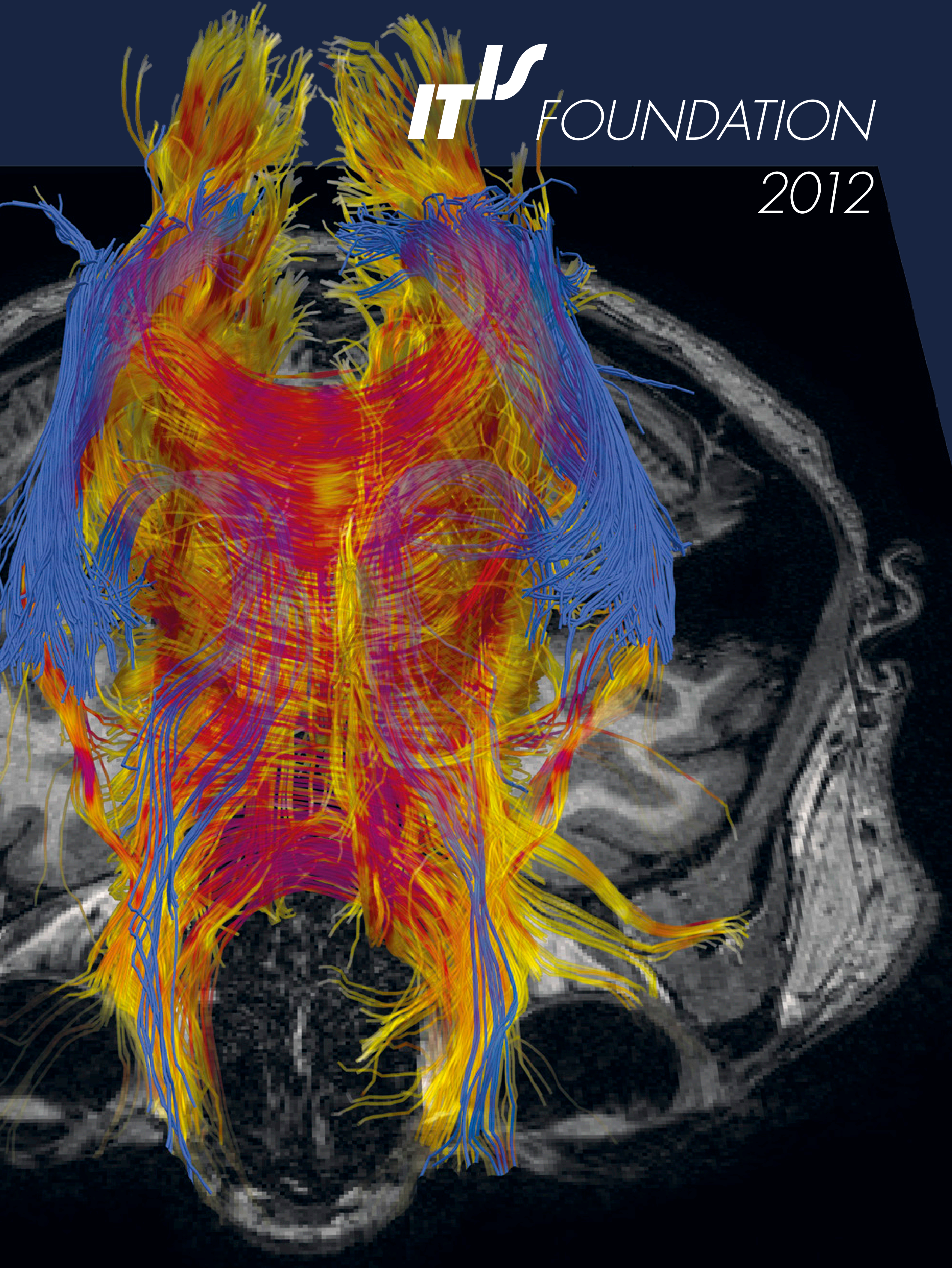
IT'IS FOUNDATION

2012



Title Page: Underlying image data with DTI-based fiber tracking to optimize the placement of dynamic neuron models for the generation of the functionalized head model (p.13). Colored according to the fractional anisotropy value.
Back Page: Highlighted tracts of the human optical system.

IT'IS FOUNDATION

In 2012, the *Wall Street Journal* nominated the word "innovation" as the most overused phrase of the year. While it is devoid of true meaning at some research institutions, the term innovation is the embodiment of the mission of IT'IS to make a tangible difference in people's lives by enhancing the safety and quality of emerging electromagnetic technologies and by contributing our knowledge to advanced medicine, particularly for the advancement of personalized medicine. As the process of research and innovation is nonlinear, interactive, cumulative, and paved with setbacks, the Foundation recommits itself each year to strengthening its infrastructure of innovation by continuously developing, sharing, testing, refining, and applying new ideas and knowledge. 2012 was no exception.

By leveraging our progress in our new initiative *IT'IS for Health*, IT'IS significantly advanced its capabilities in computational life sciences this year, converging its expanding knowledge from across the spectrum of cutting-edge science with powerful new technologies:

- Our multi-physics and multi-scale simulation platform was further expanded to include solvers with support for image-based tissue property variations, thermo-acoustic modeling of transcranial focused ultrasound neurosurgery, and an approach for fast, tissue effect-based MR safety assessment.
- Our Virtual Population family of anatomical models was expanded and enhanced to add more functional layers and dynamical information to the models. Together with the FDA (USA) and ETHZ, IT'IS is creating a functionalized high-resolution head model. Initial applications include the modeling of EM-neuron interactions to develop neuroprosthetic devices and neurostimulation-based treatments and to simulate exposure risk assessments (Page 13).
- As we are always committed to building on our core competences in RF measurements and simulations for providing rapid and accurate solutions to determine electromagnetic field exposure, to establish reliable and sound safety standards, and to identify risk factors, we developed novel magnetic resonance (MR) safety concepts that push the envelope of emerging MR technology functionality and capability without jeopardizing patient safety (Pages 14–15).
- We refocused our hyperthermia research with two new projects 1) sarcoma treatment with the KSA, PSI, and USZ and 2) an EPFL collaborative Nano-Tera Project involving superparamagnetic nanoparticles for thermal treatment.

Although our research activities have shifted to focus on medical applications, we still continue to address problems of electromagnetic exposures and potential health hazards:

- We strived to help refocus the research agenda of the bioelectromagnetics community toward mechanism-driven research by organizing the 2nd workshop on "EMF Health Risk Research: Lessons Learned and Recommendations for the Future" at Monte Verità in October 2012 (Page 16).
- We developed novel methodologies and instrumentation and procedures and tools to reliably assess the exposure and the potential adverse health risks of wireless network devices upon conclusion of the 3-year EU-funded project SEAWIND (Page 12).
- We commenced another EU-funded collaborative project, ARIMMORA, to investigate the underlying biophysical mechanisms of the epidemiologically established association between childhood leukemia and ELF exposure.

At IT'IS, we harness our individual competences, our resources, and our networks to accelerate breakthroughs. Our dedicated employees, students, senior researchers (Page 5), and Board Members (Page 4), ensure consistent performance and innovative growth, as evidenced by the seven prestigious awards bestowed on IT'IS in 2012. The effective collaborations with our partners (Page 10) built on trust, respect, and common goals also allow us to implement our research strategies to their fullest. In particular, we thank Professors Qiuting Huang, Klaas Prüssman, Gábor Székely, and Juan Mosig for co-advising our PhD students and PostDocs.

We are grateful to our many sponsors (Page 9) whose commitment and trust in our vision make it possible to pursue our goals year after year; especially, CTI, the Swiss FOPH, the SNF, and the EU.

As we recognize the growing interest in our *IT'IS for Health* activities, it is the ongoing responsibility of IT'IS to act as a catalyst and facilitate the next breakthrough. The IT'IS adventure continues.

Zurich, June 2013 *Prof. Niels Kuster*

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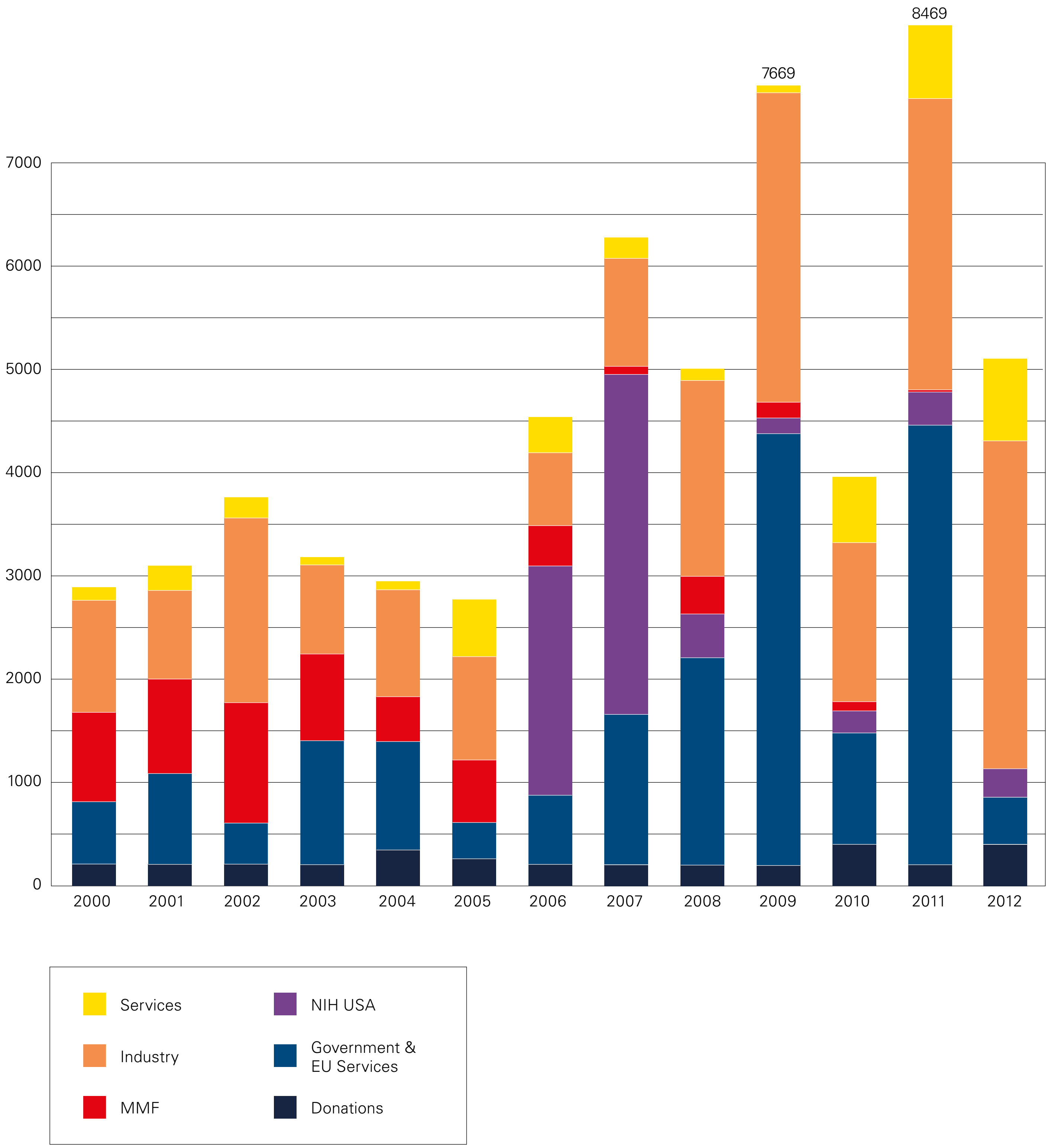
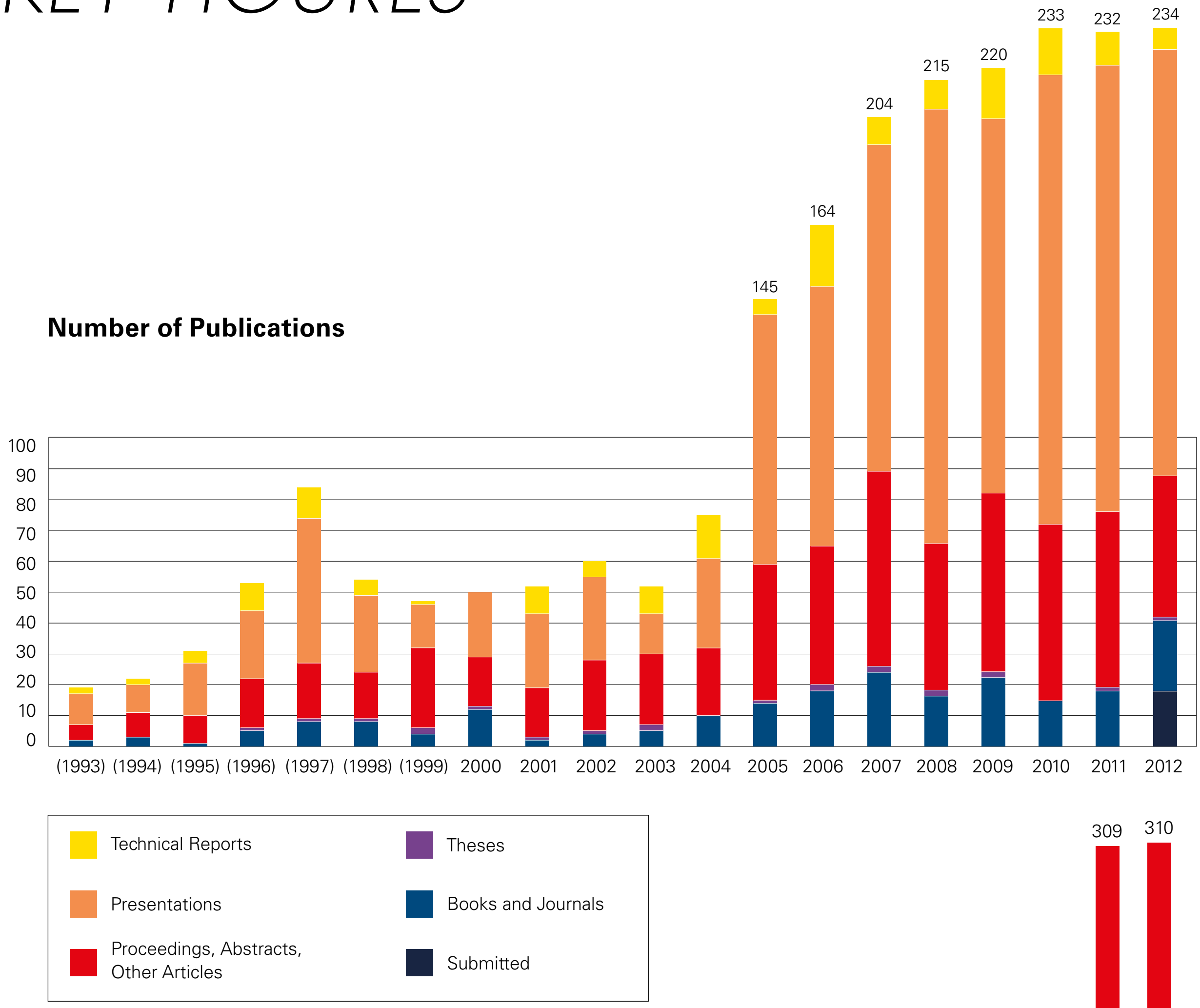
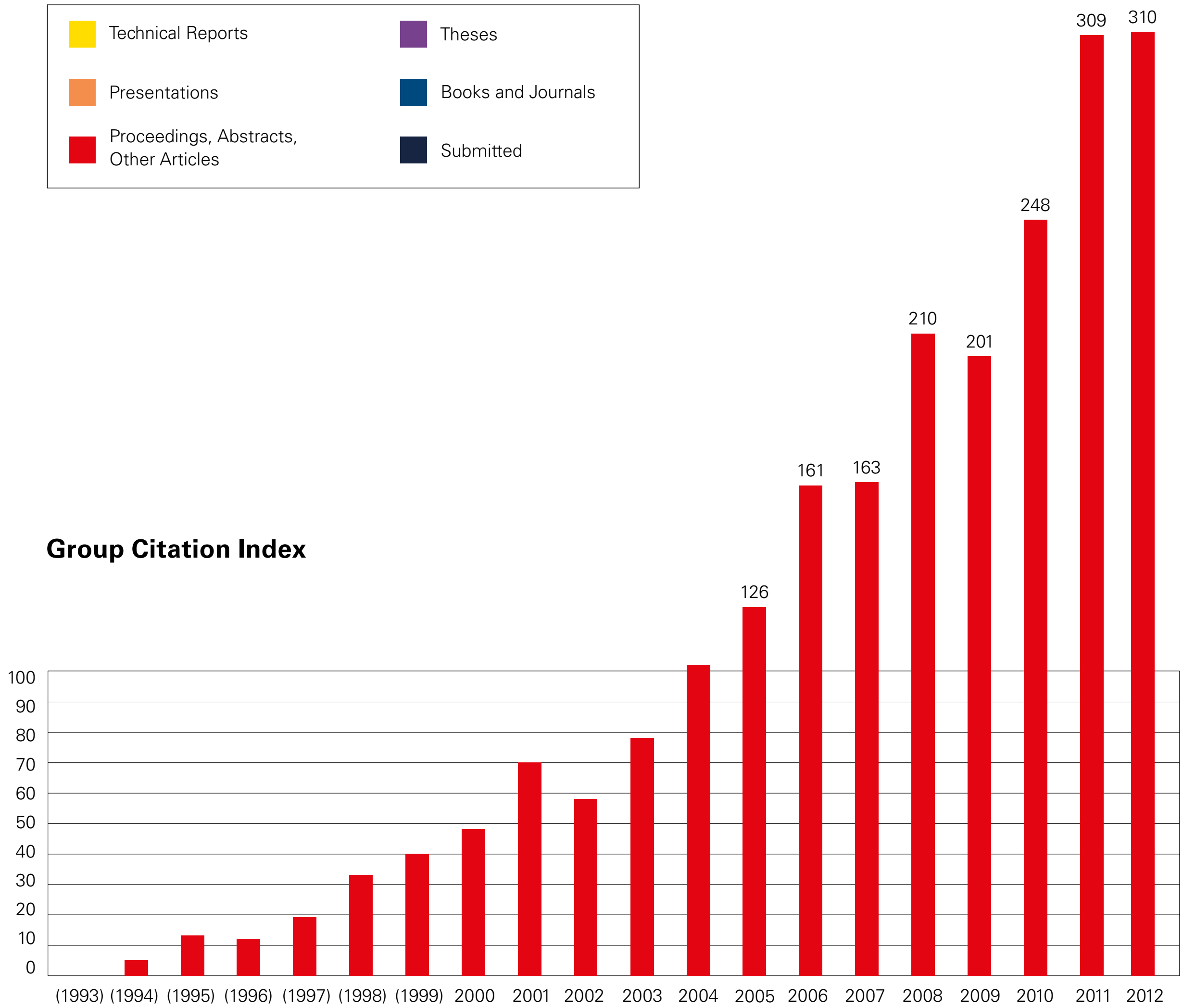


KEY FIGURES

Number of Publications



Group Citation Index



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EM Technology

TD SENSOR	Development of a field sensor in the time and frequency domains
MT SENSOR	Development of a micro-thermal sensor
DAK-TL	Development of a high-precision dielectric measurement system (DAK) for measurements of dielectric properties in solids
POSEIDON	Solvers for the next generation of waveguide and high-power devices
WEMS	Development of procedures and instrumentation for demonstration of worker's EM safety
PiX	Experimental solution for MR-safety evaluation of medical implants

EM Exposure & Risk Assessment

sXc, sXv, sXh	Development of optimized exposure systems for bio-experiments from static to GHz
sXv–NTP/NIEHS	Development, manufacturing, installation, and detailed dosimetry of the reverberation chamber-based exposure system for the NIEHS *in vivo* studies
NRP-Sleep	Effect of RF electromagnetic radiation on human sleep EEG and cognitive tasks
REPLICATIONS	Replication studies of biomedical studies with high potential for impact
ZonMw	Assessment of the exposure of children to electromagnetic fields from ELF to RF in uncontrolled environments
Ex-MSELF	Assessment of ELF current distributions induced in the human head from UMTS and GSM Mobile phones
EX-Mats	Exposure evaluation of therapeutic magnetic field mats
EXPA EPI–CTIA	Exposure assessment for epidemiological studies of mobile phone users
EX-Bulbs II	Assessment of the human exposure to EMF of energy saving long-fluorescent tubes
BAG EX-Chef II	Assessment of the current induced in workers when exposed to the magnetic fields of induction cookers
EMF & Cancer Therapy	Review of the beneficial effects of low-level EMF on cancer cells *in vitro*, *in vivo*, and in human studies
EMF & Photodynamic Therapy	Identification of optimal *in vitro* photodynamic therapy (PDT) and RF-EMF-mediated hyperthermia conditions for cancer treatment
STANDARDIZATION	Participation in regulatory activities (standards committees & governments)
FP7 ARIMMORA	Identification of possible causal relationships between EMF exposure and cancer, with a special focus on childhood leukemia
FP7 SEAWIND	Assessment of exposure and health risks due to wireless network devices

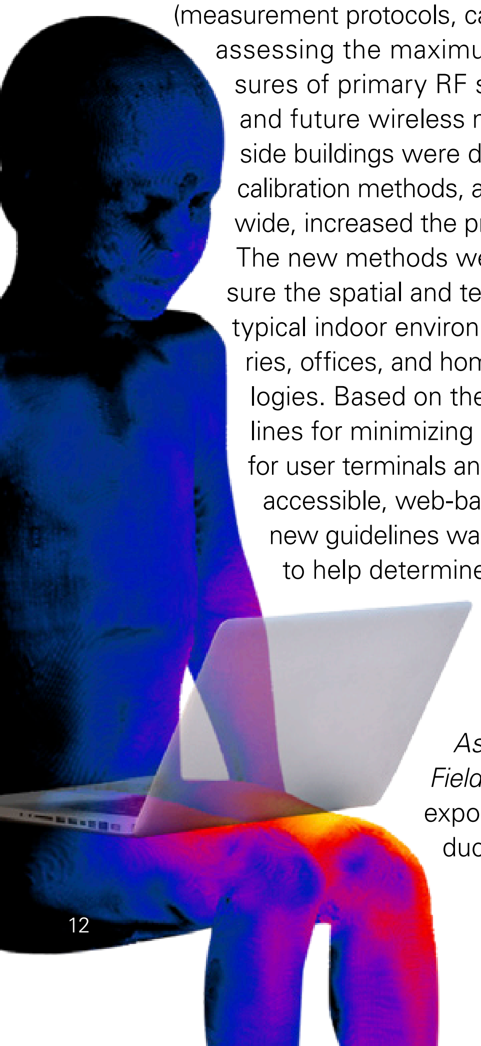
IT'IS for Health

CTI S4L-CAPITALIS	Extension of the Sim4Life platform (S4L) for analysis and optimization of neurovascular and neurological devices and treatments in the head
CO-ME III	Investigation of focused ultrasound (FUS)-induced reversible blood brain barrier (BBB) opening
EUREKA MRI+	Development of MRI exposure risk probability based on local temperature safety considerations
MRI#	Development of 3T-MRI exposure risk probability based on local temperature safety considerations
MRIneo	Development of MRI exposure risk probability of fetuses and newborns based on local temperature safety considerations
FDAhead	Functionalized high-resolution head model for EM-neuron interaction modeling
ViP Version 2.0/3.0	Development of the next generation of high-resolution anatomical models
Volumetric meshes	Generation of enhanced volume meshes
Morphing Technique	Development of a physically-based morphing tool

EVALUATION OF WIRELESS NETWORK DEVICES (FP7-ENV PROJECT SEAWIND)

As wireless network devices, such as smartphones and tablet computers, become an increasingly integral part of our personal and professional lives, our daily RF exposure is also rapidly increasing. Research efforts, however, have mainly focused on the exposure and health risk evaluations of cellular networks and mobile phones, while studies on the effects of pervasive and prolonged EMF exposure to wireless network devices on human health are lacking. The three-year EU funded collaborative project "Sound Exposure & Risk Assessment of Wireless Network Devices (SEAWIND)" was therefore initiated to close the knowledge gaps about the actual exposure and to perform preliminary biological risk assessment screenings. The consortium led by IT'IS, consisting of eight research groups from Switzerland (University of Basel, IT'IS, SPEAG), Belgium (iMinds), Denmark (University of Aalborg), Greece (AUTH), and Germany (Fraunhofer-Institute, Dialogik GmbH), successfully completed the project in November 2012.

Assessment of Incident Fields–Novel methodologies (propagation models inside rooms) and instrumentations (measurement protocols, calibration techniques) for assessing the maximum and typical exposures of primary RF sources of both current and future wireless network technologies inside buildings were developed. The improved calibration methods, already adopted worldwide, increased the precision by a factor of 20. The new methods were also applied to measure the spatial and temporal RF exposures in typical indoor environments (schools, nurseries, offices, and homes) for different technologies. Based on these new results, guidelines for minimizing exposure were derived for user terminals and access points. A freely accessible, web-based tool containing these new guidelines was subsequently developed to help determine the optimal location of access points for minimizing the exposures in apartments and houses.



Assessment of Induced Fields–Estimates of the mean exposure and the range of induced fields from various wireless network devices were obtained based on a transformation matrix relating incident fields and induced fields across various tissue types constructed from over 7,000 simulations using the Virtual Population models. Mobile phone usage as a wireless access point and in direct contact with the body, i.e., via tethering, yielded the highest exposures. In this configuration, the maximum exposure may exceed the safety limits depending on the phone model. The estimated mean exposure at the maximum data rate was also higher than that of the phone used in talk mode. To reduce the user's exposure, it is thus recommended to keep the phone at least 50 mm from the body in tethering mode. Using more modern UMTS technology in talk mode also reduces the mean exposure levels by a factor of 100 compared to GSM. The cumulative exposures for the transmission of fixed-size data packets were approximately equal for UMTS and WiFi, whereas the exposure duration for GSM, which has much lower data transfer rates, was longer by a factor 10–100, resulting in a higher cumulative exposure.

Biological Screening–Novel genotoxicity screening tools were developed to determine the potential impact of wireless network exposures on genome integrity. Four test signals representing the most relevant communication systems (GSM, UMTS, WiFi, and RFID) were created to maximize the likelihood of evoking a biological response. No DNA damage induced by mobile-phone specific signals was identified. In addition, there was no indication of any potential direct damage to DNA caused by the newly explored signal modulations used in modern data transfer technologies. Modulation-specific interferences, however, could not be excluded, and EMF may potentially interfere with cellular homeostasis. These results will stimulate and guide future investigations on EMFs as putative co-carcinogenic or co-stress factors, which might potentiate adverse health effects under specific circumstances.

Risk Governance and Communication–Guidelines and recommendations based on a risk evaluation analysis were developed for government officials to spur the creation of a more effective and appropriate approach to risk governance.

We believe that these achievements will significantly impact the direction and reliability of future EMF research (see www.seawind-fp7.eu).

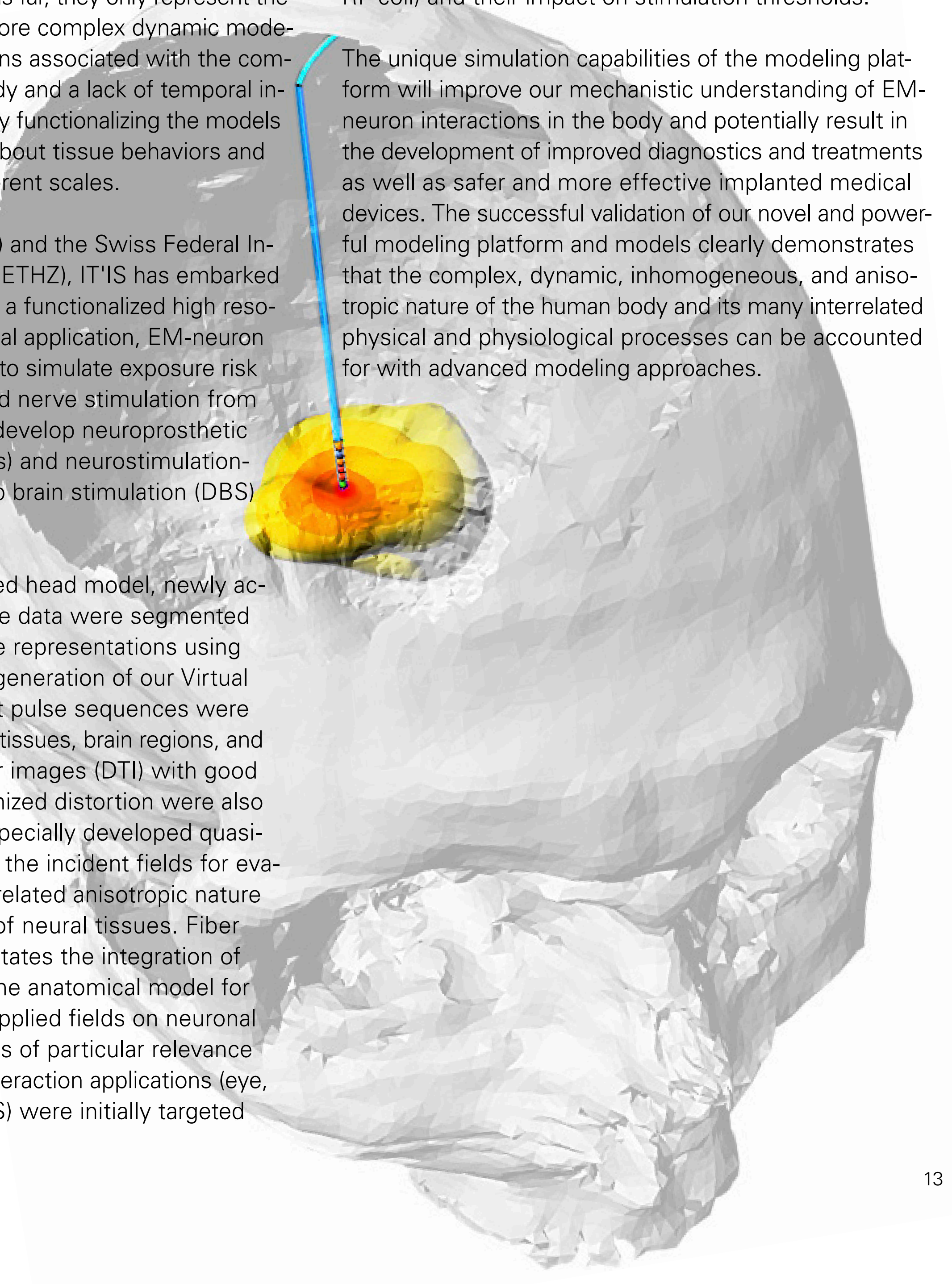
FUNCTIONALIZED HEAD MODEL FOR EM-NEURON INTERACTION MODELING

The development of detailed anatomical human and animal models for EMF exposure assessment and computational life sciences applications has long been a cornerstone of research at IT'IS. By pairing these models with novel, efficient solvers optimized for the modeling of living tissue, the beneficial and adverse interactions between external stimuli and physical, biological, and physiological processes occurring within the body can be investigated. Although static, geometric anatomical models have provided invaluable information thus far, they only represent the essential starting point for more complex dynamic modeling strategies. Their limitations associated with the complex nature of the human body and a lack of temporal information can be overcome by functionalizing the models with dynamical information about tissue behaviors and property distributions at different scales.

Together with the FDA (USA) and the Swiss Federal Institute of Technology Zurich (ETHZ), IT'IS has embarked on a new challenge to create a functionalized high resolution head model. As an initial application, EM-neuron interactions will be modeled to simulate exposure risk assessments (e.g., unwanted nerve stimulation from an MR gradient coil) and to develop neuroprosthetic devices (e.g., artificial retinas) and neurostimulation-based treatments (e.g., deep brain stimulation (DBS) to treat Parkinson's disease).

To generate the functionalized head model, newly acquired high quality MR image data were segmented and transformed into surface representations using the tools developed for the generation of our Virtual Population models. Different pulse sequences were applied to distinguish various tissues, brain regions, and vasculature. Diffusion tensor images (DTI) with good angular resolution and minimized distortion were also acquired and paired with a specially developed quasi-static EM solver to calculate the incident fields for evaluating the fiber orientation-related anisotropic nature of the dielectric properties of neural tissues. Fiber tracking in the DTI data facilitates the integration of dynamic neuron models in the anatomical model for studying the impact of the applied fields on neuronal activity. Selected sub-regions of particular relevance with regard to EM-neuron interaction applications (eye, inner ear, brain nuclei in DBS) were initially targeted for neuron model integration. A framework for coupling EM simulations with neuronal dynamics simulations was also devised. Successful validation of the modeling platform was achieved by reproducing neuronal dynamics simulations (e.g., DBS related). As a first application, the commonly applied SENN model for low frequency exposure safety assessments was integrated into the framework and extended to consider temperature related effects (e.g., due to local hotspots caused by the MR RF coil) and their impact on stimulation thresholds.

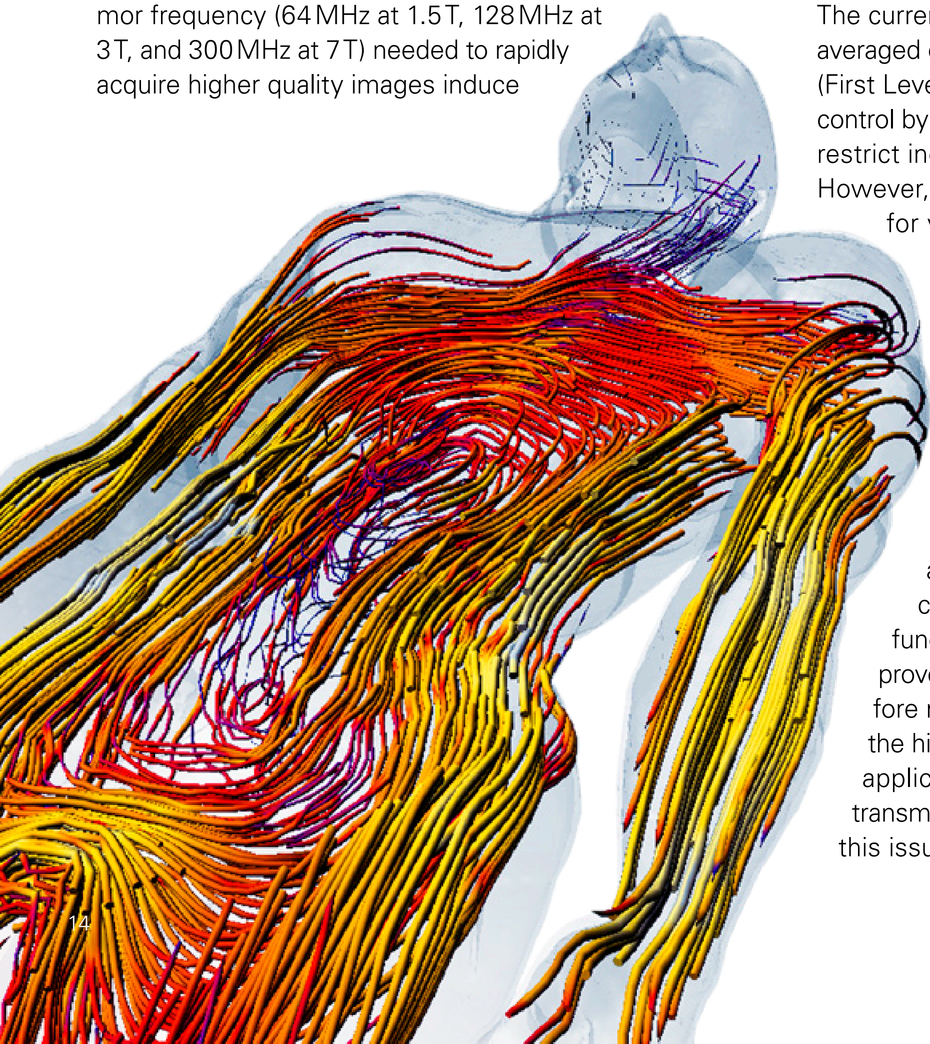
The unique simulation capabilities of the modeling platform will improve our mechanistic understanding of EM-neuron interactions in the body and potentially result in the development of improved diagnostics and treatments as well as safer and more effective implanted medical devices. The successful validation of our novel and powerful modeling platform and models clearly demonstrates that the complex, dynamic, inhomogeneous, and anisotropic nature of the human body and its many interrelated physical and physiological processes can be accounted for with advanced modeling approaches.



PUSHING THE ENVELOPE TOWARD ADVANCED RF MR SAFETY CONCEPTS

Magnetic Resonance Imaging (MRI) has revolutionized the non-invasive diagnosis and treatment of a broad spectrum of medical conditions over the past three decades. Our colleagues at the Institute of Biomedical Engineering at ETH Zurich have pioneered several major breakthroughs during the past two decades. In recent years, MR has become ever more cutting-edge with the combination of new hardware (e.g., multi-transmit coils, traveling wave) and novel pulse sequences to improve image quality and facilitate advanced diagnostic and functional imaging capabilities. However, to ensure that MRI will remain at the forefront of imaging research and clinical practice in the future, safety considerations must be constantly reviewed to accommodate new and future advances in MR techniques and applications.

Although higher magnetic field strengths and faster pulse sequences offer greater diagnostic and research imaging capabilities, they also present many new challenges in terms of technical and physical consequences. For example, the fast and high amplitude RF pulses at the Larmor frequency (64 MHz at 1.5 T, 128 MHz at 3 T, and 300 MHz at 7 T) needed to rapidly acquire higher quality images induce undesired currents in the tissues, resulting in thermal whole-body and partial-body stress and local hotspots due to the RF absorption. Appropriate new safety measures must therefore be considered and implemented for both normal patients and patients with special conditions, such as pregnancy, medical implants, thermoregulation impairments (e.g., diabetes, advanced age, and anesthetization), and obesity. Also, with the advent of next generation MR systems characterized by higher magnetic field strengths (7 T and beyond) and more sophisticated RF transmission, their effects on human health must be assessed meticulously.



As these novel technologies emerge, IT'IS is committed to build upon its core competences in RF measurements and simulations for providing rapid and accurate solutions to determine electromagnetic field exposure, establish reliable and sound safety standards, and identify risk factors.

Exposures in MR Scanners

The current IEC safety guidelines limit the whole-body averaged exposures to 2 W/kg (Normal Mode) and 4 W/kg (First Level Mode): the exposures are relatively easy to control by power measurements and the stipulated limits restrict increases of the maximum core temperature. However, our initial study to determine local exposures for various Virtual Population models placed in different landmark positions inside generic birdcage resonators revealed that critical local temperature levels (> 42 °C) can be reached during long but clinically occurring scan times. These levels were also much higher than the maximum tolerable temperature specified in the latest standard for MR scanners. Despite these higher than anticipated thermal hotspots, MRI diagnostics have demonstrated an impressive history of safe use. Enforcing the current temperature limits would reduce MRI functionality and effectiveness to levels far below proven safety limits. New safety concepts are therefore needed to make the standard consistent with the historical safety data and to make the restrictions applicable to future technologies, such as multi-transmit coils. To effectively and opportunely address this issue, IT'IS formed an international consortium

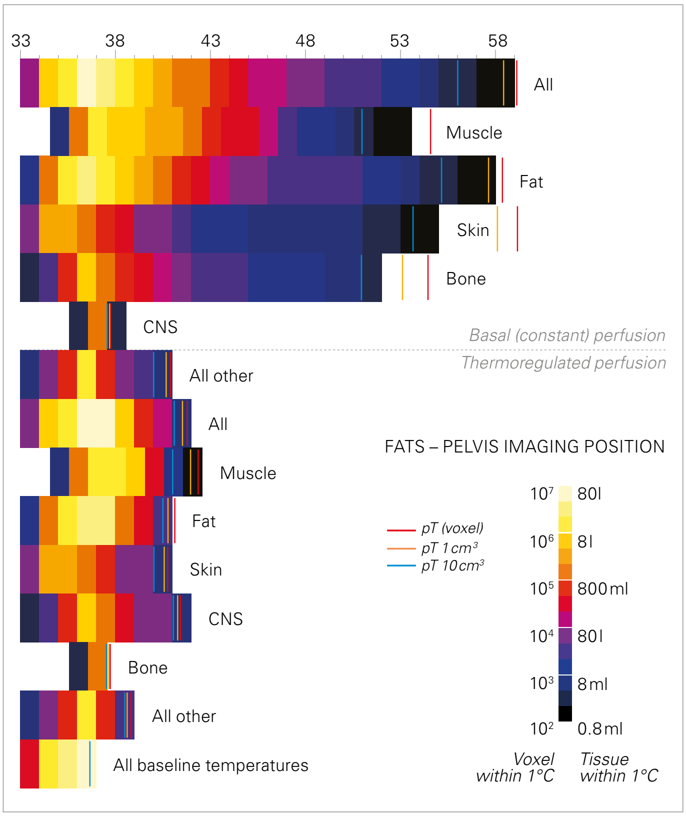
(MRI+) comprised of leading academic research groups, MR manufacturers, standardization committees, and regulatory agencies under the EU funding umbrella EUREKA.

Thermal Workshop
IT'IS and the MRI+ consortium organized the "Thermal Workshop on RF Hotspots" in March 2011 to review the state of the art of tissue damage assessment. The 31 participating international experts concluded that the CEM43 (cumulative equivalent minutes at 43°C) model is the most thoroughly investigated and most suited model for predicting tissue damage. The corresponding dose values for different tissues at which permanent damage can be excluded and upon which future MR safety concepts can be based were defined and published (Page 19).

Novel MR Safety Concepts
In an initial study, we analyzed the correlation between RF absorption and large-scale anatomical features (e.g., height, BMI) as a potential basis for the new safety concepts. However, the correlation between anatomy and induced local SAR was weak for a normalized whole-body exposure but strong for a fixed incident RF magnetic field. The whole-body SAR can be up to 2.5 times higher (local SAR up to seven times) in obese adult models compared to children. In a second study, we enhanced our advanced thermal solver with the CEM43 model to investigate if the effects of thermal stress on tissues can be reliably assessed. The results were consistent with the historical safe use of MR scanning and sufficiently robust to serve as a basis for future MR safety concepts and real-time online control. B1+ mapping and skin temperature measurements in a human validated the findings. In two follow-up projects, MRI# and MRIneo, we will investigate the special considerations for safeguarding vulnerable groups, such as patients with impaired thermoregulation (e.g., the elderly, diabetics) and for fetuses and neonates.

MR Safety for Patients with Medical Implants
Generally, patients with active medical implants are excluded from MRI examinations. Although evaluation methods for passive implants exist, their reliability is questionable based on the recently acquired detailed knowledge about the variations of *in vivo* absorptions. IT'IS has actively participated in a joint ISO/IEC working group to develop reliable and sound testing methods for demonstrating the MR safety of active implants. Our novel RF evaluation methods, which combine *in silico* and experimental evaluations, are included in the first version of the prospective standard IOS/TS 10974. A second version is currently in preparation. The software and hardware developed for these evaluations, such as generic MITS birdcages, phantoms, and the PiX system, became spin-off products of ZMT. IT'IS is also actively involved in developing a novel "fixed parameter mode" for MR scanners that provides better-defined limits for the safe scanning of certified medical implants.

Novel Real-Time MR Safety Control Concepts
The next step is to develop fast real-time methods for reliably predicting tissue damage. The IT'IS Foundation is committed to synthesizing the accumulated knowledge to improve MR diagnostics far beyond its current state of the art by prudently reducing the safety margins based on advanced understanding.



RESHAPING THE FUTURE OF BIOELECTROMAGNETICS ON MONTE VERITÀ 2012

From October 21–25, 2012, 129 participants from 24 countries gathered on Monte Verità, Ascona, Switzerland for the second "EMF Health Risk Research: Lessons Learned and Recommendations for the Future" workshop. The first workshop, held seven years earlier, was very influential, paving the way for much recent outstanding research. By 2012, the time had come to reconvene, assess the progress achieved, identify remaining knowledge gaps, and set priorities for the future of the field.

Following the recommendations issued in 2005, a number of studies were replicated in independent laboratories and certain results, such as the effects of EMF exposure on EEG and genome stability, were successfully reproduced, whereas others were not. Yet, interaction mechanisms between weak fields and human cells remain unelucidated, and the observed biological responses unexplained. Without this fundamental mechanistic understanding, assessing the risks associated with human exposure to EMFs is difficult, and extrapolating existing results to novel exposure sources, modulations, and different frequency ranges remains largely impossible. Thus, the focus of the 2nd workshop was on reproducible effects of low-level EMF on organisms, on mechanisms of interaction between weak EMFs and human tissues, and on the most promising experimental approaches to substantiate the interaction. As in 2005, the number of presentations was limited to the most controversial topics and results, and extensive debates were encouraged.

During the final round of discussions, research priorities were defined to identify EM-biosensors, i.e., to identify mechanism(s) that couple physical fields to chemistry within a biological system, such that biological responses can be reproducibly measured. Based on the collective knowledge of all participants, the following interaction mechanism-driven bioexperiments were suggested as the most promising:

- radical pair mechanisms at RF & ELF exposure levels: the cryptochrome family of proteins is of particular interest, as these share sequence homology and biochemical properties with photolyase DNA repair enzymes, which may play a role in cancer development;
- large magnetic particles at ELF exposure levels: these are present at an estimated >500 million particles per gram in brain tissue and have been suggested as sites of interaction since the 1990s; investigation with state-of-the-art tools could offer new insights;
- quantum biology for ELF & RF exposure levels: coherent quantum processes are likely to be ubiquitous in biology, and novel results in that field need to be closely reviewed in the context of bioelectromagnetics;
- mitogenic responses at intermediate frequency (IF) exposure levels of 10 kHz to 1 MHz: mitotic spindle disruption by IF-EMF has been proposed as a potential mechanism by two research groups and is worth investigating more closely;
- cellular regulatory pathways at ELF & RF exposure levels: gene transcription and protein stability via the activation of mitogen-activated protein kinase (MAPK) cascades may contribute to epigenetic DNA modifications and to deregulation of gene expression.
- interference with complex neural networks at ELF and RF exposure levels: circadian rhythms, brain function, aging, and sleep may be impacted.

Final recommendations regarding the biosystems and signals to be addressed include:

- hypothesis-driven generic exposure instead of anthropogenic signals, e.g., high peak-to-average RF signals, DC versus AC, and intermittent frequencies;
- well-understood and well-controlled biosystems, e.g., engineered tissues and cells combined with *in silico* methods;
- high sensitivity systems and methods, e.g., hypersensitive cells with specific defects in DNA transactions and response and novel transgenic animal models;
- parametric studies on complex neural networks, e.g., circadian rhythms, brain function, aging, and sleep.

Our workshop on Monte Verità was made possible through the commitment and professionalism of all the contributing scientists, all the personnel involved with the organization, and all our generous sponsors. Many thanks to everybody!

SERVICES

The IT'IS Foundation offers a wide range of R&D services to develop solutions and applications ranging from multi-scale and multi-physics simulations to near-field measurements in the fields of physics, engineering, and medicine for partners in academia, industry, and government. These services harness the expertise and skills of our researchers and employees as well as our state-of-the-art laboratory (see Page 18). Services include, but are not limited to:

RF Safety and Compliance Evaluation of Transmitters
The IT'IS Foundation is regarded as the preeminent, truly independent institute for dosimetric evaluation. We are committed to developing the most accurate, flexible, and suitable testing procedures in conjunction with regulators, national standards laboratories, and industry. Our close cooperation with leading system manufacturers (e.g., SPEAG, ZMT) allows us to provide the best possible services using the most recent and cutting-edge testing technologies.

MR Safety and Compliance Evaluation of Implants
The IT'IS Foundation offers reliable and efficient solutions to address MR safety and the compliance of active and passive implants in MR environments according to the latest ISO/IEC recommendations. Our involvement in standardization committees and joint projects with major regulatory bodies enables us to extend our network of partners and remain competitive in the field. Our comprehensive solutions include test planning development, numerical and experimental evaluations, and the preparation of documentation for FDA submissions.

Communication Link System Design
The IT'IS Foundation provides expert consultations on standards and homologation rules, including the revision of technical requirements, the assessment of regulation procedures, and the evaluation of impending standards. We also offer full development and design services for custom-specific antennas with optimized link budgets when operated in complex environments, e.g., on-body or inside the body.

Computational Life Science Evaluations and Analyses
In silico evaluations can generate complementary predictions that augment clinical trial outcomes, especially for poorly represented subgroups. We couple our expertise in computational engineering, tissue modeling, functionalized anatomical modeling, and regulatory processes and standards to maintain our excellence in computational life sciences. The IT'IS Foundation provides expert customized analyses and evaluations of specific medical diagnostic and therapeutic applications using its cutting-edge multi-scale and multi-physics simulation software platform.

Exposure Systems
The IT'IS Foundation designs and develops various exposure systems for *in vitro*, *in vivo* and human studies on EM interactions. These systems can be customized to meet specific needs and are optimized for efficiency, flexibility, and environmental control while providing maximum homogeneity, a wide dynamic range, and a variety of amplitude modulation schemes. The exposure systems are suitable for a wide range of applications including health risk assessments, therapeutic efficacy assessments, and evaluations of the interaction mechanisms associated with exposure to electromagnetic fields.

Safety White Papers
The IT'IS Foundation provides a full range of safety white papers, resulting from its extensive research activities in health risk assessment and active participation in commissions developing EMF and MRI safety guidelines. Numerous international organizations, industries, and government agencies have entrusted the Foundation to draft white papers for existing and future technologies as well as for specific devices.

EMF Workshops
The IT'IS Foundation organizes customized workshops on EMF-related issues in collaboration with our national and international partners. On-site and specialized workshops and seminars can also be arranged upon request.

INFRASTRUCTURE

Dosimetric, Near-Field and EMC/EMI Facilities

Semi-Anechoic Chamber
This shielded, rectangular chamber has the dimensions 7x5x2.9m (LxWxH). It is equipped with a reflecting ground plane floor, and half of its walls are covered with electromagnetic absorbers. The chamber contains an integrated DASY52NEO system and can be utilized for all research activities involving dosimetric, near-field and far-field evaluations, the optimization and synthesis of handheld devices, body-mounted transmitters, implants, desktop applications, micro-base and pico-base station antennas, exposure setups, calibration procedures, EMI tests, MRI safety tests, compliance testing of implants, etc.

Two Reverberation Chambers
The Blue and NIEHS reverberation chambers have the dimensions 4x3x2.9m and 3.7x2.2x2.7m (LxWxH), respectively. Both chambers are equipped with two mechanical stirrers and provide controlled and consistent environments for EM emissions and immunity testing, as well as shielding effectiveness and susceptibility testing of electromagnetic equipment.

Facility for Dosimetric Compliance Testing
IT'IS shares a facility with Schmid&Partner Engineering AG, which meets the requirements for dosimetric evaluations. Class C accreditation is expected in 2013 through METAS for all types of dosimetric evaluations.

Technical Equipment and Instrumentation

Spectrum and Network Analyzers
1 HP 8753E Network Analyzer, 30kHz–6GHz
1 HP APC 85033B Calibration Kit
1 Rohde&Schwarz FSP Spectrum Analyzer, 9kHz–30GHz
1 Rohde&Schwarz ZVA24 Vector Network Analyzer, 10MHz–24GHz
1 Rohde&Schwarz ZVA50 Vector Network Analyzer, 10MHz–50GHz
1 Rohde&Schwarz ZV-Z52 Calibration Kit

Signal Generators and Testers
3 Agilent 33120A, Waveform Generators
1 Agilent 33250A, Waveform Generator
1 Agilent E8251A Signal Generator, 250KHz–20GHz
3 Anritsu 3700A
2 Anritsu MG3700A
1 HP 8647A, Signal Generator 250KHz–1000MHz
1 Rohde&Schwarz CMU200
1 Rohde&Schwarz CMW500
1 Rohde&Schwarz CTS55, Digital Radio Tester
1 Rohde&Schwarz SMIQ02B, Signal Generator
4 Rohde&Schwarz SML02/03, Signal Generators
1 Rohde&Schwarz SMU200A, Signal Generator
1 Rohde&Schwarz SMY02, Signal Generator

DASY, iSAR, EASY4MRI, MITS
1 INDY (3 year child head) Phantom
1 ISABELLA (6 year child head) Phantom
1 SPEAG AMIDV2, Audio Magnetic Field Probe
1 SPEAG AMIDV3, Audio Magnetic Field Probe
3 SPEAG ASTM Phantoms
2 SPEAG DAE4, Data Acquisition Electronics
4 SPEAG DAEasy4MRI, Data Acquisition Electronics
1 SPEAG DAK 12/3.5/1.2E
2 SPEAG DASY52NEO Systems
2 SPEAG EASY4MRI
2 SPEAG EE3DV1, E-Field Probes
1 SPEAG EF3DV6, E-Field Probe
2 SPEAG ELI4 Phantoms
2 SPEAG ER3DV6, E-Field Probes
1 SPEAG ET1DV1, Dosimetric Probe
2 SPEAG ET1DV2, Dosimetric Probes
3 SPEAG ET3DV6, Dosimetric Probes
1 SPEAG EU2DV2, Probe
1 SPEAG EX3DV3, Dosimetric Probe
2 SPEAG H3DV6, H-Field Probes
2 SPEAG H3DV7, H-Field Probes
1 SPEAG HAC RF Extension
1 SPEAG HAC T-Coil Extension
1 SPEAG HU2DV2, Probe
4 SPEAG iSAR^2 (2 Flat, 1 Head, 1 Quad)
1 SPEAG SAM V6.0 Phantom
9 SPEAG T1V3LAB/TSIL, Temperature Probes
1 ZMT MITS 1.5 w/Phantoms
1 ZMT MITS 3.0 w/Phantoms
1 ZMT MITS Gradient

Meters
3 Agilent 34970A Data Acquisition Units
2 Agilent E4419B, 4 HP 8482A, Power Meters
2 Handyscope HS3/4 Data Acquisition Unit
3 HP 436A, 3 HP 8481A, Power Meters
1 Magnet Physik FH49–7030, Gauss/Teslameter
1 METROLAB, THM 1176, Magnetic Field Sensor
2 Rohde&Schwarz NRP2 Power Meters

Amplifiers
1 Amplifier Research 10S1G4A, Amplifier, 800MHz–4.2GHz
1 Kalmus 717FC RF Power Controller, 200–1000MHz
1 LS Elektronik 2450 Amplifier, 400W/900MHz
3 LS Elektronik 2449 Amplifiers, 200W/900MHz
2 LS Elektronik 2448 Amplifiers, 60W/900MHz
3 LS Elektronik 2452 Amplifiers, 200W/1800MHz
1 LS Elektronik 2451 Amplifier, 60W/1800MHz
1 LS Elektronik 2447 Amplifier, 5W/1800MHz
2 LS Elektronik 2780 Amplifiers, 40W/2140MHz
8 Mini-Circuits Amplifiers, ZHL42, 700–4200MHz
2 Mini Circuits Amplifiers, ZVE-8G, 2–8GHz
1 Nucletudes ALP336 Amplifier, 1.5–2.5GHz
2 Ophir 5141, 700MHz–3GHz

Other Equipment
8 Maury 1878B, 3-Step Tuners
1 Narda EHP-50 EM Field Probe Analyzer, 5Hz–100KHz
1 Narda ELT-400 Magnetic Field Probe, 1Hz–400KHz
2 SPEAG Dipoles SCC34 Benchmark
3 SPEAG, SHO V2 RB, RC&RP, OTA Hand Phantoms
6 SPEAG Validation Dipoles D835, D900, D1640, D1800, D2450, D5GHz

Computers
(41) Laptop Computers (from Apple, Asus, Lenovo, Dell)
(2) Intel Core i7 based, 16–31GB RAM, (11) Intel Core i7 based, 4–15GB RAM, (5) Intel Core i5 based, 4–15GB RAM, (1) Intel Core i3 based, 4–15GB RAM, (9) Intel Core2Duo based, 1–3GB RAM, (13) Intel Core2Duo based, 4–15GB RAM
(43) Workstation Computers (custom built, from Acceleware, Dalco, Dell, HP)
(1) Intel Xeon based, dual socket, 32–63GB RAM, (3) Intel Xeon based, 16–31GB RAM, (1) Intel Xeon based, 4–15GB RAM, (2) Intel Core i7 based, 32–63GB RAM, (4) Intel Core i7 based, 16–31GB RAM, (11) Intel Core i7 based, 4–15GB RAM, (2) AMD Phenom based, Dual socket, 16–31GB RAM, (1) AMD Opteron based, Dual socket, 64–127GB RAM, (5) AMD Opteron based, Dual socket, 16–31GB RAM, (2) AMD Opteron based, Dual socket, 4–15GB RAM, (3) AMD Opteron based, 4–15GB RAM, (8) Intel Pentium 4 based; Dell, 1–3GB RAM
(7) Clusters and Specialized Computational Systems (from Dalco, NVidia)
(1) NVidia S1040 based computational cluster, 4 nodes (each with 4xNVidia T10 GPUs, 16GB VRAM, QuadCore CPUs, 32GB RAM), (2) Intel Xeon based, Dual socket, 64–127GB RAM, Quad Tesla GPU, (4) Intel Xeon based, Dual Socket, >128GB RAM
(6) Servers (from Apple, Dalco, Synology)
(1) Intel Xeon based, Dual socket, 4–15GB RAM, (2) Intel Atom based NAS, >30TB network file storage, (1) Intel Core2Duo based, 4–15GB RAM, (1) AMD Opteron based, Dual socket, 16–31GB RAM, (1) IBM PowerPC G5 based: Apple Mac Pro, 1–3GB RAM
(21) Miscellaneous Computer Hardware
(2) NVidia Tesla GPU PCIe Cards (attached to workstations), (12) NVidia QuadroPlex, Dual Quadro FX5600 GPU, PCIe interface (attached to workstations), (4) Apple AirPort Extreme WiFi base stations, (2) Xerox Monochrome Laser Printer, (1) Xerox Color Laser Printer

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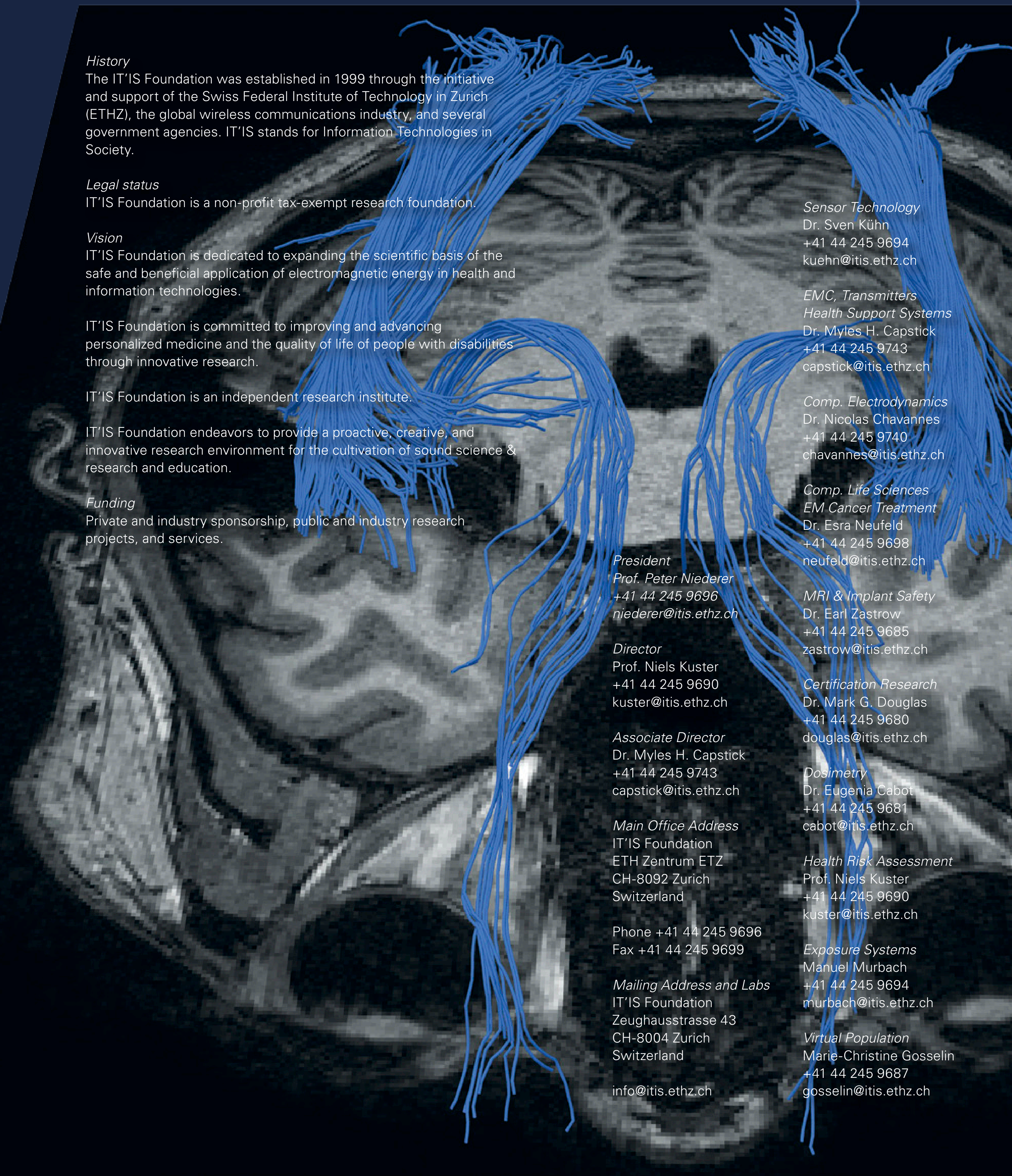
IT'IS FOUNDATION



History
The IT'IS Foundation was established in 1999 through the initiative and support of the Swiss Federal Institute of Technology in Zurich (ETHZ), the global wireless communications industry, and several government agencies. IT'IS stands for Information Technologies in Society.

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