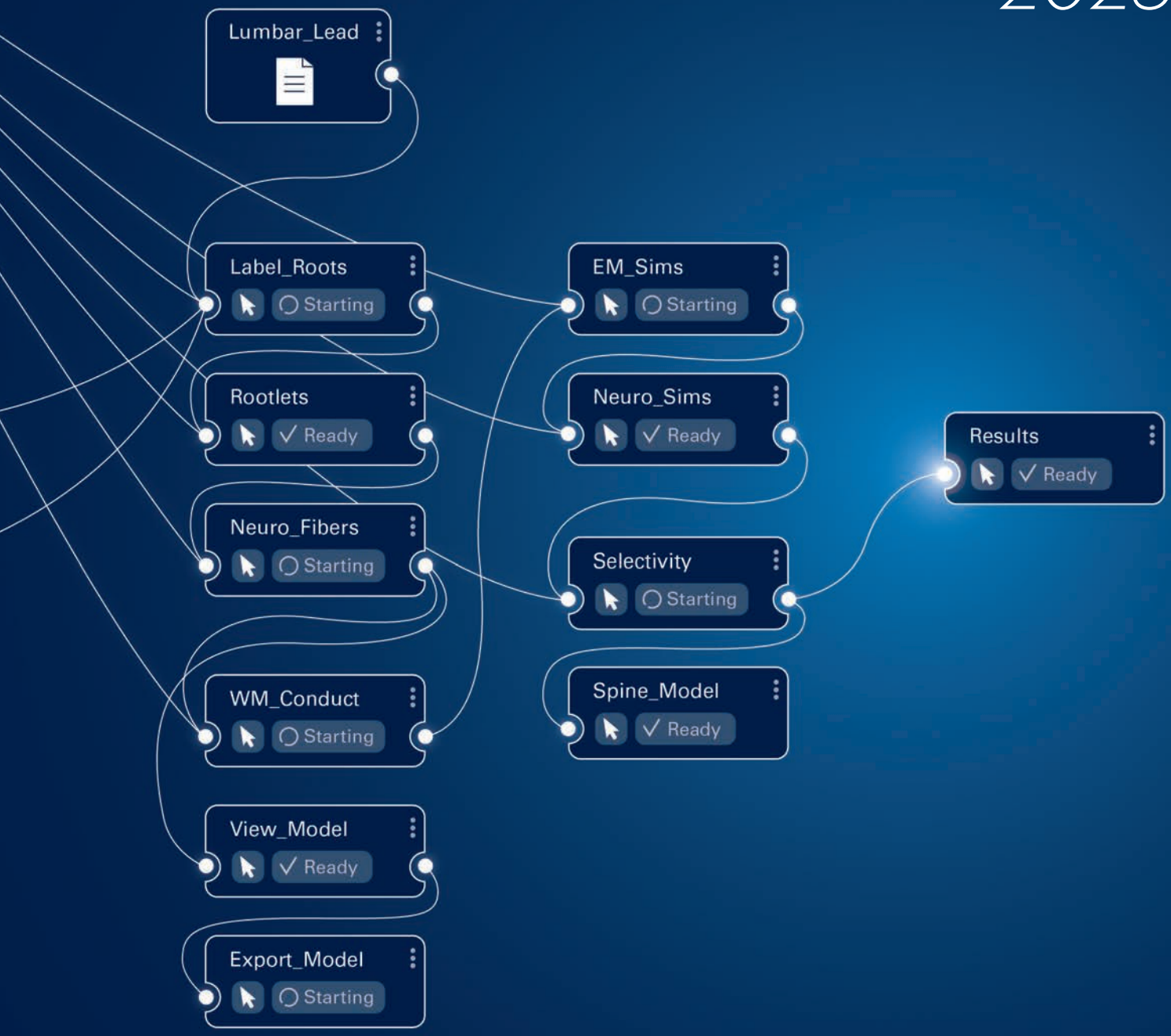
IT'IS FOUNDATION 2025



Cover: An o²S²PARC pipeline for personalized spinal cord stimulation modeling, from lead placement and neuroanatomical segmentation through electromagnetic and neuronal simulation to selectivity analysis.

SCIENTIFIC SUCCESS IN THE YEAR 2025

In the past year, the world has grown more polarized, with social and political norms shifting almost daily and global rules increasingly shaped by a few powerful actors. This volatility has also transformed the scientific world: international collaboration is disrupted, and research funding has become tighter, more competitive, and less globally oriented.

Small institutions like IT'IS and its alliance partners are particularly exposed to these trends. Our value lies in highly specialized expertise, services, and products that depend on open international collaboration and diversified funding. As such, our role in maintaining diverse, agile networks and shaping emerging agendas becomes even more important.

In response, we have chosen not to retreat, but to reinforce what makes us distinct. We continue to invest in exceptional talent while concentrating on our core strengths in electromagnetic (EM) near-fields, computational life and health sciences (CLaHS) and neuromodulation. We assume that today's turbulence is temporary, and we are preparing to emerge more resilient and even stronger in the future.

2025 was an eventful year for IT'IS. The generous funding of more than USD 20 million from the U.S. National Institutes of Health (NIH) for the cloud-based o^{2}S^{2}PARC platform, provided as part of the SPARC program over the past eight years, has come to an end. With o^{2}S^{2}PARC, IT'IS supported the SPARC effort to advance the development of electroceutical devices by mapping and decoding the autonomic nervous system and fostering translational research through collaborative, reproducible, and FAIR (Findable, Accessible, Interoperable, and Reusable) computational modeling across diverse tools and workflows. The achievements are summarized on pages 12 –13.

o^{2}S^{2}PARC, with our functionalized Virtual Population, has evolved from a grant-supported resource to a unique infrastructure. We will continue to enhance performance – extending functionality, refining the user interface, and adapting to additional scientific application domains. To this end, we are investing our own funds while actively seeking alternative funding to secure the platform's long-term development and scientific impact.

The SEAWave project, with its focus on measurement technologies for assessment of exposure and possible skin cancer risk associated with 5G frequency range 2 (FR2) millimeter-wave emission, has also concluded. Z43 focused on determining realistic skin models, compliance testing, methodologies for base-station exposure evaluation, and the development of exposure systems that were provided to project partners for *in vitro, in vivo,* and human studies. With the help of IT'IS, SPEAG developed the first commercial system for evaluating absorbed power density from FR2 devices – an important step for regulatory testing and device certification. The conclusions reached in the final risk assessment, led by the International Agency for Research on Cancer (IARC) and based on both past and new results, indicate that current evidence linking 5G FR1 and FR2 exposure to skin cancer remains inconclusive.

Temporal interference stimulation (TIS) has become a flagship initiative at IT'IS, integrating hardware innovation, mechanistic modeling, and translational neuroscience. Our achievements encompass advanced TIS hardware, fully automated personalized planning tools, mechanistic investigations, and brain-state-aware stimulation strategies. Expanding international collaborations attest to the growing global recognition of our leadership in this field.

Finally, an increasing number of projects are being supported through the Katja Poković Research Fund (page 11).

All of the above achievements were made possible by the dedication of our researchers, external advisors (page 5), and Board Members (page 4). We extend our sincere thanks to Prof. Alex Dommann for his exceptional leadership for the past years, and to Profs. Quirino Balzano, who will lead IT'IS into new frontiers from 2026, as well as to Profs. Qiuting Huang, Mathieu Luisier, Lukas Novotny, and Klaas Prüssmann for their vital support and mentorship. We are equally grateful for the clinical expertise of Profs. Beatrice Beck Schimmer, Stephan Bodis, and Alvaro Pascual-Leone, and for the guidance of Profs. Peter Achermann and Primo Schär.

Our success in 2025 demonstrates that agility, scientific excellence, technological innovation, and strategic collaboration combine to provide a strong foundation for navigating global change.

Niels Kuster

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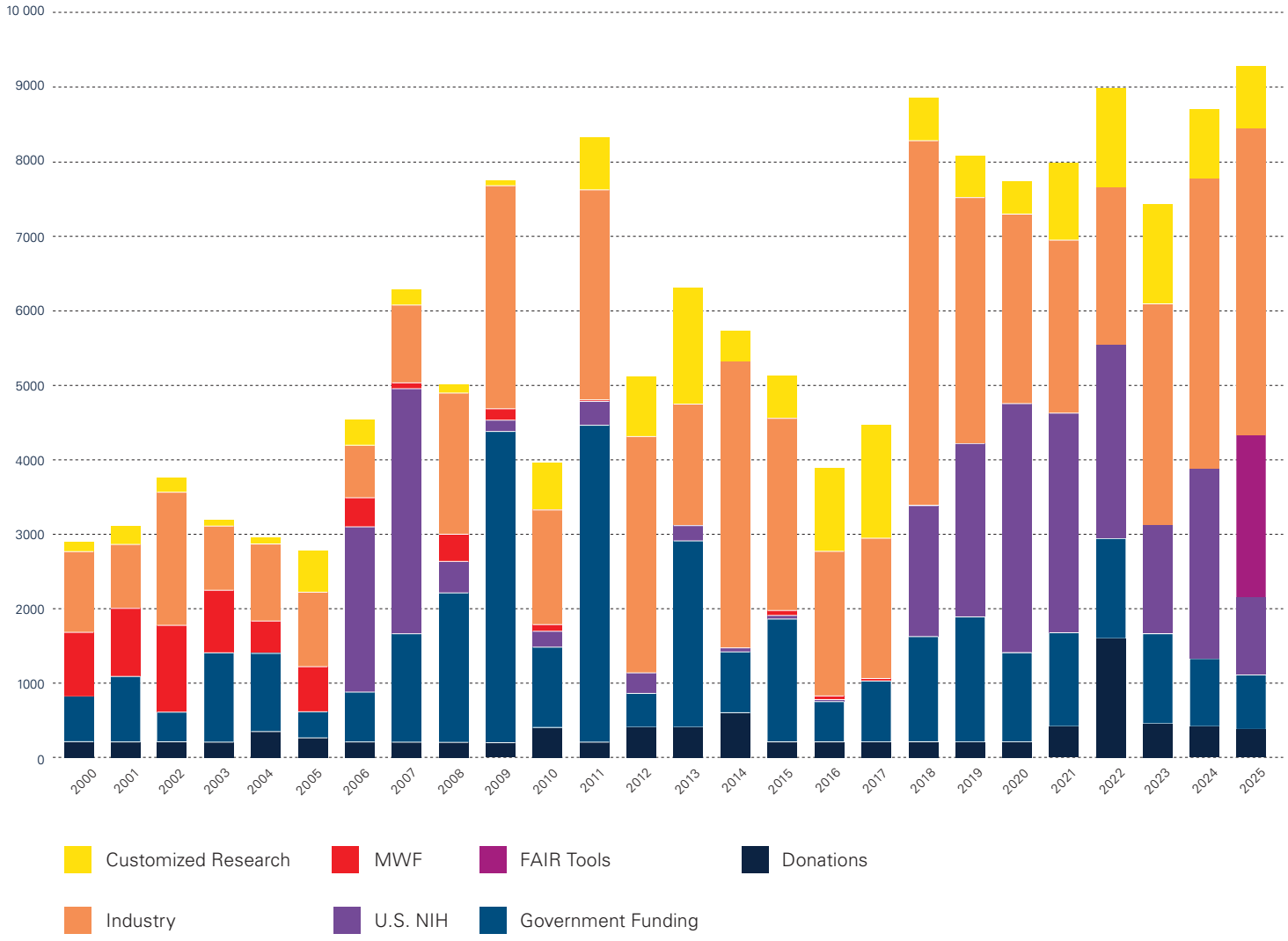
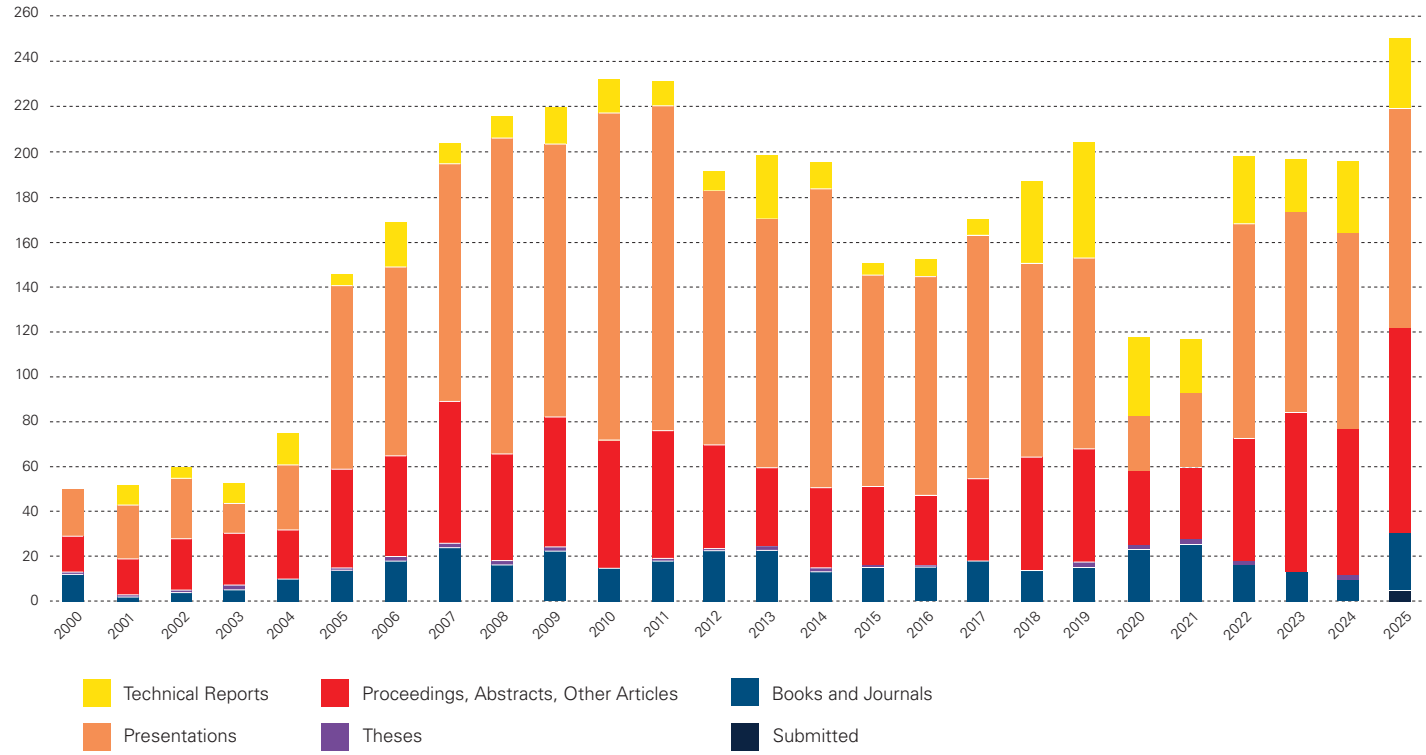
KEY FIGURES

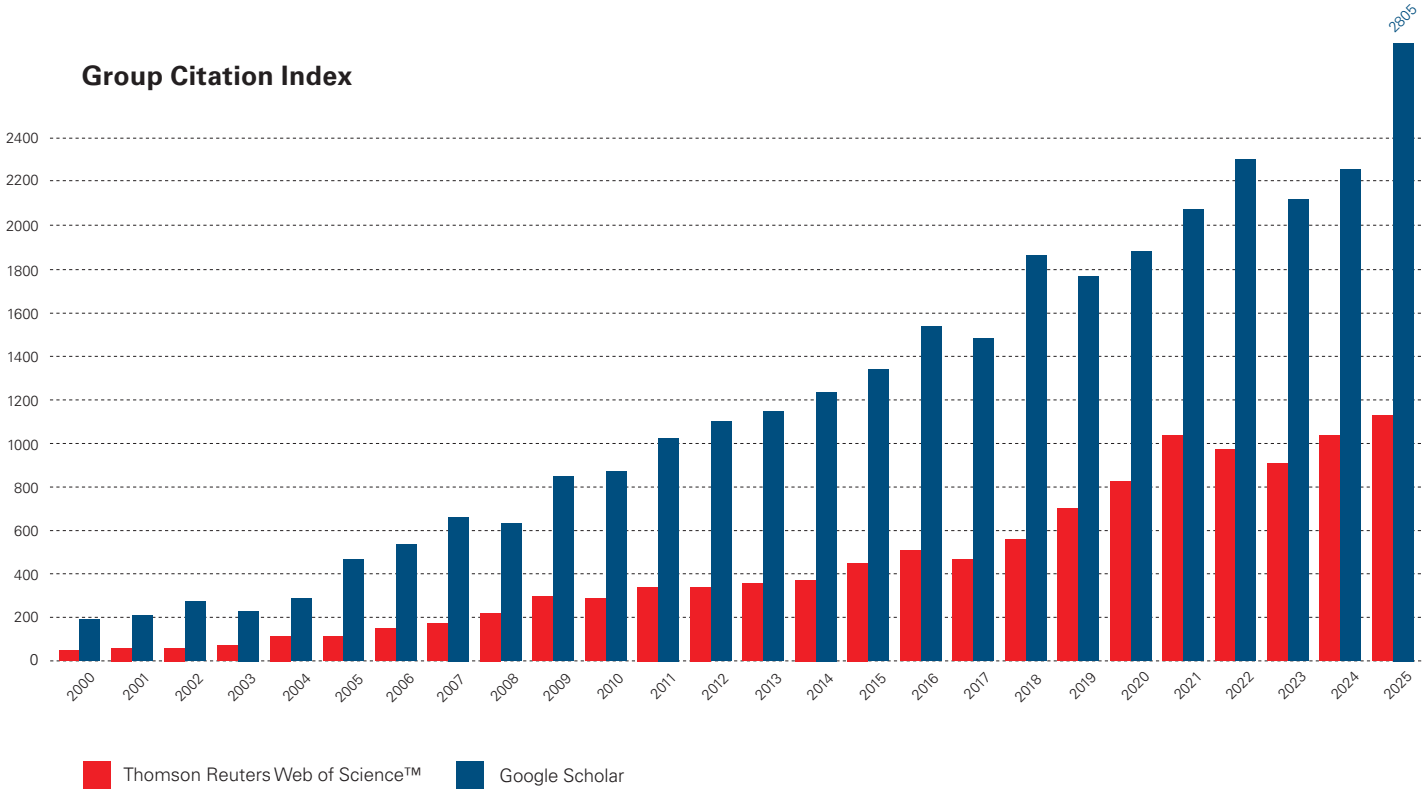
Level of Funding (in 1000 CHF)



Number of Publications



Group Citation Index



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Electromagnetic Technology

5&6GEARS	Development of an ultra-miniature wideband 5G and 6G electromagnetic radiation sensor for future mobile communication systems
Dielectric Spectroscopy	Development of novel methodologies for characterization of materials at frequencies ranging from direct current to >100 GHz
expo6G	Multi-modal optimization of 5G and 6G hybrid wireless and internet of things communication networks in Switzerland
MEWS	Metrology for emerging wireless standards
MRIcompLEAD	Development of leads compatible with magnetic resonance imaging
KPRF* – cMOST	Nearfield frontend application-specific integrated circuit (ASIC)
KPRF* – HMTF	Understanding effects of heterogeneous media on transfer functions
Science for Standards	Provision of science in support of electromagnetic product standards and support of standards committees and government agenciess
STASIS / MRI – Implant Safety	Metrology and standardization for safe implant scanning in magnetic resonance imaging

Computational Life and Health Sciences

KPRF* – MSAT	Development of a computational multiscale model of human male and female anatomy
o^2S^2PARC	Establishment of an interactive, freely accessible online computational platform for simulating peripheral nervous system neuromodulation / stimulation
PersonalizedSTIMO	Personalized epidural electrical stimulation of the lumbar spinal cord for clinically applicable therapy to restore mobility after paralyzing spinal cord injury
SENS-THERM	Development of hardware and software for electromagnetic sensing, video control, and meta-modeling in thermotherapy of advanced head and neck (H&N) cancer
SPARCLE	Small form factor implantable pulse generators for chronic and lifestyle related disease management
UNMOD	Experimentally validated computational pipeline of ultrasound propagation and neuron-coupling for non-invasive peripheral nervous system stimulation
V&V40	Development of novel concepts for verification and validation of computational life and health science software platforms and their applications
ViP 4.x / P/VM/M	Development of the next generation functionalized computational anatomical models, enhanced volume meshes, and physically realistic morphing tool

Temporal Interference

C-STIM	Focal virtual lesioning to study cognitive functions of the cerebellum
KPRF* – MATISSE	Temporal interference stimulation in a thalamocortical sleep model
KPRF* – mTI	Evaluation of multi-channel temporal interference stimulation and optimization
KPRF* – TIME-IT	Unveiling the mechanisms of temporal interference stimulation by means of complementary metal–oxide–semiconductor multi-electrode arrays
NIMBUS	Non-invasive neuromodulation of deep brain structures for upper limb recovery after stroke by transcranial temporal interference electric stimulation
TIBS-R / TIBS-Home / TIP	Development of the next generation temporal interference brain stimulators and planning tools
TIME	Establishment of temporal interference stimulation to treat epilepsy by minimally invasive targeting of deep brain structures

Electromagnetic Exposure and Risk Assessment

Sleep Studies	A causal role for a voltage-gated $Ca_v1.2$ calcium channel in mediating non-ionizing radiation 5G frequency range 1 effects on sleep associated brain health in humans?
SEAWave	Scientific-based exposure and risk assessment of radiofrequency and millimeter wave systems from children to elderly (5G and beyond)
RADIOFERTI	Investigation of the impact of 5G radiofrequency on male reproductive function in rats

**Project funded by the Katja Poković Research Fund (KPRF). The fund has been established in memory of Katja Poković to continue her scientific legacy, to advance education and research in her fields of interest, and to promote female researchers and engineers.*

A PLATFORM BUILT TO LAST: THE o²S²PARC STORY

In 2025, the U.S. National Institutes of Health (NIH) Common Fund's SPARC Program concluded an extraordinary journey, and, with it, our 8-year involvement in it building o²S²PARC[1] (open, online simulations for SPARC), an advanced open-access platform for computational modeling. The cloud-based platform, designed to support collaborative, reproducible, and sustainable research, is structured in accordance with findable, accessible, interoperable, and reusable (FAIR) principles for transparency and long-term usability of computational workflows. SPARC has concluded, but o²S²PARC continues to operate and evolve, providing critical infrastructure to support computational life and health sciences research projects in academia and industry worldwide.

The NIH's SPARC Program was established in 2015 to accelerate the development of "electroceutical" devices – therapeutic systems that modulate electrical activity in the autonomic nervous system (ANS) to improve organ function. As the ANS regulates essential physiological processes – cardiovascular, gastrointestinal, respiratory, urological, and metabolic functions – targeted neuromodulation holds promise for new treatments of chronic diseases that significantly impact morbidity and quality of life. The SPARC program's major advances in research to decode neural signaling and demonstrate the feasibility of novel therapeutic strategies include a comprehensive map of ANS structure, establishment of new technologies, and an in-depth knowledge base. The outcomes are maintained via the SPARC Portal[2], an open neuroscience and systems physiology repository containing multi-species data, knowledge, computational modeling, and spatial mapping.

IT'IS joined the effort in 2017 with a mandate to support all modeling activities across the program, ensure that computational evaluations are reproducible and sustainable long-term, and enable diverse simulation, analysis, and visualization tools to be combined into user-friendly pipelines. We answered that mandate by creating o²S²PARC and championing its adoption.

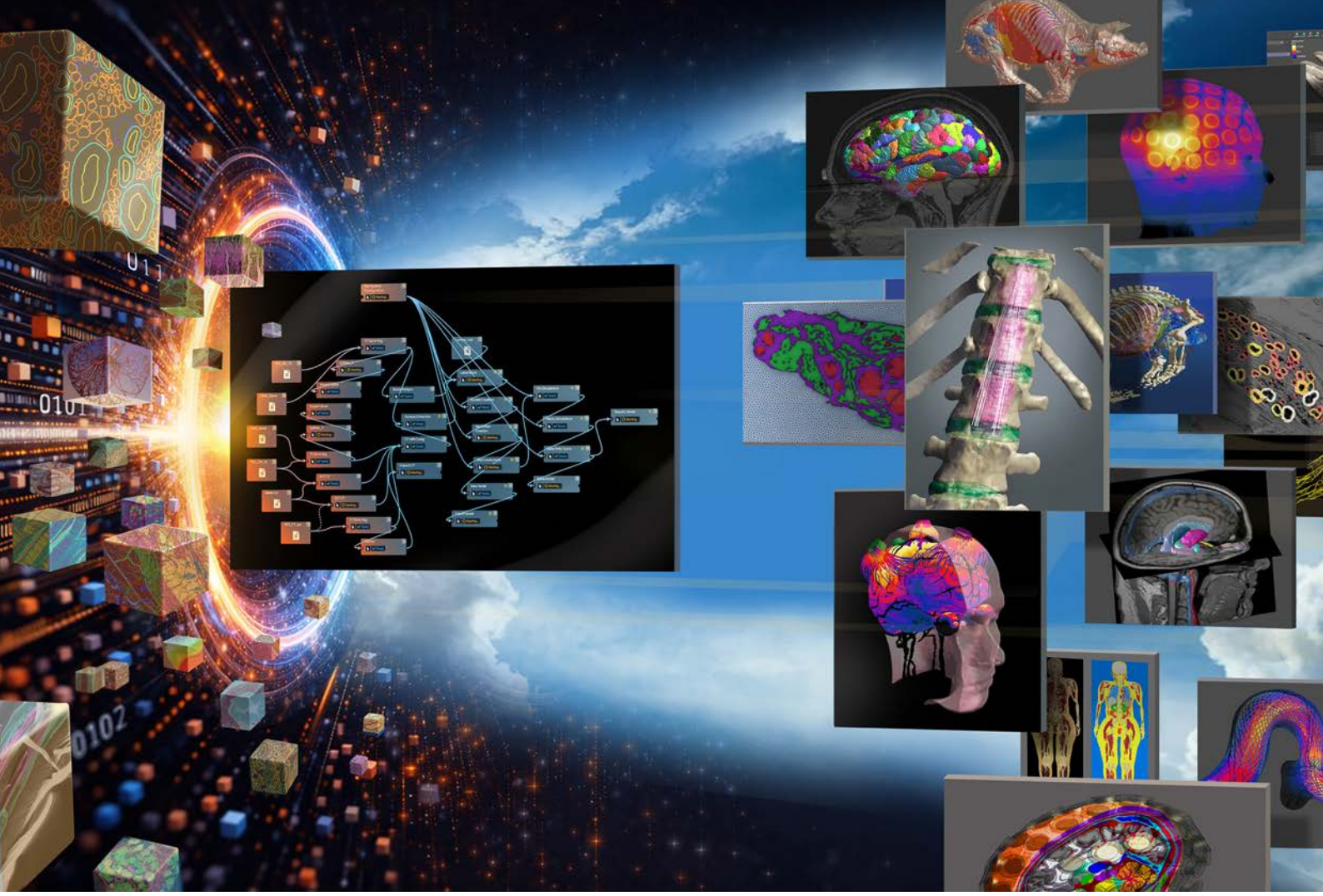
A Cloud-Native Ecosystem for FAIR Modeling

o²S²PARC runs in the cloud, requiring nothing more than a web browser or the Python environment's powerful application programming interface to access scalable high-performance computing on demand. Over 100 services now span image processing, artificial intelligence (AI) training, finite element modeling, systems biology, data analysis and visualization, organ physiology, and more. The platform orchestrates deployment, facilitates communication and pipelining between diverse services, and versions each service together with its runtime environment to ensure that studies can be faithfully reproduced in the future. Support for minimal information standards and the "Ten Simple Rules for Evaluating Model Credibility" further strengthens reproducibility, quality assurance, and FAIR-ness.

The o²S²PARC platform features an intelligent meta-modeling framework that allows any computational study or pipeline to be parameterized. Thanks to this framework, an *in silico* study of neural interface safety that included uncertainty quantification could be performed; waveform optimization was used to boost the power efficiency of commercial implants; manufacturers could identify electrode configurations optimized for safety and efficacy; and brain activity models could be personalized to improve electroencephalogram features for adaptive stimulation protocols. In another landmark application, o²S²PARC's closed-loop control framework was used to enable model-predictive regulation of cardiac activity in heart transplant patients to compensate for the loss of vagal innervation, resulting in experimentally confirmed improvements in heart rate adaptation.

o²S²PARC-Powered Applications and Resources

The technologies developed for o²S²PARC also influence and expand the ecosystem of Z43's leading computational multiphysics platform, Sim4Life. o²S²PARC powers Sim4Life.lite, providing students with accessible cloud-based tools for their studies, and Sim4Life.web[3] – a cloud-native edition of our Sim4Life platform that delivers a desktop-class simulation experience directly through the browser – is built on the same codebase. With on-demand, scalable computing resources, Sim4Life.web[3] is well suited for users with peak workloads. For instance, one research consortium uses it to process over 2,000 magnetic resonance imaging scans, extract anatomy, and run biomechanical simulations, with findings fed seamlessly into a machine-learning service for neural network training.



From autonomic nervous system mapping to brain stimulation planning, neuroprosthetics, and hyperthermia therapy optimization: a mosaic of o²S²PARC-powered applications illustrating the breadth of computational life sciences workflows that can be created, shared, and reproduced on the platform.

Beyond high-throughput research, o²S²PARC allows expert workflows to be packaged as guided applications, so that researchers with limited computational experience can effectively perform advanced simulations, e.g., to develop planning tools that are already deployed in clinical research. Examples include our Temporal Interference Planning (TIP) tool for brain stimulation, a spinal cord stimulation planner for restoring locomotion in paraplegics, and a treatment optimization tool for hyperthermia cancer therapy, now nearing completion, that uses model-predictive closed-loop control to improve outcomes by running parallel continuously updated scenarios based on sparse feedback during therapy.

These examples illustrate how o²S²PARC has grown well beyond ANS applications, into neuroprosthetics, brain stimulation, and broader life and health sciences. o²S²PARC has been used as a dissemination platform for tools developed for International Electrotechnical Commission (IEC)/Institute of Electrical and Electronics Engineers (IEEE) exposure safety standards, to provide simulation results as interactive supplements to high-impact publications, and as a practical teaching platform for courses in neuroanatomy, computational neuroscience, bioelectronics, and electromagnetic dosimetry.

Continued Enhanced Performance and Expanded Functionality

The SPARC program can celebrate manifold achievements that deepen our understanding of ANS-mediated organ regulation and lay the groundwork for novel therapeutic approaches to chronic disease, but the o²S²PARC adventure is far from over. The steadily growing user community adopting the platform only strengthens our resolve to continue development to enhance performance, expand functionality, and refine the user experience.

[1] osparc.io
[2] sparc.science
[3] Sim4Life.web

INFRASTRUCTURE

Dosimetric, Near-Field, and EMC/EMI Facilities

Semi-Anechoic Chamber

This shielded, rectangular chamber has the dimensions 7 × 5 × 2.9 m (L × W × H). It is equipped with a reflecting ground plane floor, and half of its walls are covered with baffling panels to absorb electromagnetic waves. The chamber, which contains an integrated DASY52NEO system, can be used for research activities involving: dosimetric, near-field, and far-field evaluations; the development and optimization of handheld devices, body-mounted transmitters, implants, desktop applications, micro-base and pico-base station antennas, exposure setups, and calibration procedures; electromagnetic interference, magnetic resonance imaging safety, and compliance testing of implants; and more.

Facility for Radiofrequency Compliance Testing

IT'IS shares with Schmid & Partner Engineering AG a facility equipped with the latest DASY8 systems for testing device compliance with any national and international guidelines, standards, and regulations as well as for a wide range of research and development measurement tasks related to exposure to electromagnetic waves at frequencies from 3 kHz to 110 GHz. The facility is accredited per ISO/IEC 17025.

Technical Equipment and Instrumentation

Spectrum and Network Analyzers

1 Copper Mountain R60 Vector Reflectometer
1 HP 8753E Network Analyzer, 30 kHz – 6 GHz
1 HP APC 85033B Calibration Kit
1 Keysight E5061B Vector Network Analyzer, 5 Hz – 1.5 GHz
1 Rohde & Schwarz FSP Spectrum Analyzer, 9 kHz – 30 GHz
1 Rohde & Schwarz FPL1003 Spectrum Analyzer, 5 kHz – 26 GHz
1 Rohde & Schwarz ZVA24 Vector Network Analyzer, 10 MHz – 24 GHz
1 Rohde & Schwarz ZVA50 Vector Network Analyzer, 10 MHz – 50 GHz
1 Rohde & Schwarz ZVA67 Vector Network Analyzer, 10 MHz – 67 GHz
1 Rohde & Schwarz ZV-Z52 Calibration Kit
1 NI PXIe-5668R Vector Signal Analyzer, 100 kHz – 26.5 GHz

Signal Generators and Testers

3 Agilent 33120A, Waveform Generators
1 Agilent 33250A, Waveform Generator
1 Agilent E8251A Signal Generator, 250 kHz – 20 GHz
3 Anritsu 3700A Vector Signal Generators
2 Anritsu MG3700A Vector Signal Generators
1 HP 8647A Signal Generator, 250 kHz – 1 GHz
1 Rohde & Schwarz CMU200 Universal Radio Communication Tester
1 Rohde & Schwarz CMW500 Wideband Radio Communication Tester
1 Rohde & Schwarz CTS55 Digital Radio Tester
1 Rohde & Schwarz SMIQ02B Signal Generator
2 Rohde & Schwarz SML02 Signal Generators
1 Rohde & Schwarz SML03 Signal Generator
1 Rohde & Schwarz SMT06 Signal Generator
1 Rohde & Schwarz SMU200A Signal Generator
1 Rohde & Schwarz SMY02 Signal Generator
1 Rohde & Schwarz SMW200 Vector Signal Generator
1 Spectrum DN2.816-02 16-Bit Hybrid Netbox

DASY, cSAR3D, ICEy, DAE, EASY4MRI, EASY6, MITS, PiX, Phantoms, Resonators

1 INDY (3-year-old child head) Phantom
1 ISABELLA (6-year-old child head) Phantom
1 SPEAG ASTM Phantom
5 SPEAG cSAR3D (2 Flat, 1 Left Head, 1 Right Head, and 1 Quad)
2 SPEAG DAE4, Data Acquisition Electronics
1 SPEAG DAE4A, Data Acquisition Electronics
2 SPEAG DAE4ip, Data Acquisition Electronics
4 SPEAG DAEasy4MRI, Data Acquisition Electronics
2 SPEAG DASY52NEOs
1 SPEAG EASY4MRI
2 SPEAG EASY6
4 SPEAG EASY6 DAE, Data Acquisition Electronics
2 SPEAG ELI4 Phantoms
1 SPEAG HAC Radiofrequency Extension
1 SPEAG HAC T-Coil Extension
1 SPEAG ICEy-EMC and -mmW
1 SPEAG SAM V6.0 Phantom
3 SPEAG SHO V2 RB, RC, and RP OTA Hand Phantoms
1 ZMT MITS1.5 with ELIT Phantoms
1 ZMT MITS3.0 with ELIT Phantoms
2 ZMT Dual Cylinder Phantoms
1 ZMT MITS Gradient V1
1 ZMT MITS Gradient V2
1 ZMT PiXE64
1 ZMT MITS-HFR1.5
1 ZMT MITS-HFR3.0
1 ZMT MITS-TT

Probes

1 Greisinger GMH 5430 Conductivity Meter
1 METROLAB THM 1176 Magnetic Field Sensor
3 Osensa Temperature Probes
1 SPEAG 1RU1PXI TDS Remote Unit
1 SPEAG AMIDV2 Audio Magnetic Field Probe
1 SPEAG AMIDV3 Audio Magnetic Field Probe
1 SPEAG DAK Kit 12 / 3.5 / 1.2E
1 SPEAG DAKS-12 Probe
2 SPEAG E1TDSz Electric Field Time Domain Sensor and Remote Units
1 SPEAG E1TDSx-ICEy Electric Field Time Domain Sensor
1 SPEAG E1TDSz-ICEy Electric Field Time Domain Sensor
1 SPEAG EE3DV1 Electric Field Probe
1 SPEAG EF3DV3 Electric Field Probe
1 SPEAG EL3DV2 Electric Field Probe for Wireless Power Transfer
2 SPEAG ER3DV6 Electric Field Probes
1 SPEAG ES3DV2 Electric Field Probe
1 SPEAG ET1DV4 Dosimetric Probe
2 SPEAG ET3DV6 Dosimetric Probes
1 SPEAG EU2DV2 Dosimetric Probe
1 SPEAG EUmmW Electric Field Probe
1 SPEAG EX3DV3 Dosimetric Probe
4 SPEAG EX3DV4 Dosimetric Probes
3 SPEAG H1TDSx Magnetic Field Time Domain Sensor and Remote Units
1 SPEAG H1TDSx-ICEy Magnetic Field Time Domain Sensor
1 SPEAG H1TDSz-ICEy Magnetic Field Time Domain Sensor
4 SPEAG H3DV6 Magnetic Field Probes
3 SPEAG H3DV7 Magnetic Field Probes
1 SPEAG HL3DV2 Magnetic Field Probe for Wireless Power Transfer
1 SPEAG HU2DV1 Magnetic Field Probe
2 SPEAG T1V3 Temperature Probes
2 SPEAG T1V3LAB Temperature Probes
1 SPEAG T1V4LAB Temperature Probe
5 SPEAG RFoF1P4MED Probes and 1 Remote Unit

Meters

3 Agilent 34970A Data Acquisition Units
2 Agilent E4419B and 4 HP 8482A Power Meters
3 Agilent HP 436A and 3 HP 8481A Power Meters
1 Handyscope HS3 Data Acquisition Unit
1 Handyscope HS4 Data Acquisition Unit
1 Magnet Physik FH49 – 7030 Gauss / Teslameter
2 Rohde & Schwarz NRP2 Power Meters

Amplifiers

1 Amplifier Research 10S1G4A, Amplifier, 800 MHz – 4.2 GHz
1 Kalmus 717FC RF Power Controller, 200 MHz – 1 GHz
8 Mini-Circuit ZHL42 Amplifiers, 700 MHz – 4.2 GHz
2 Mini-Circuit ZVE-8G Amplifiers, 2 – 8 GHz
1 Nucletudes ALP336 Amplifier, 1.5 – 2.5 GHz
2 Ophir 5141 Amplifiers, 700 MHz – 3 GHz

Other Equipment

1 Narda EHP-50 Electromagnetic Field Probe Analyzer, 5 Hz – 100 KHz
1 Narda ELT-400 Magnetic Field Probe, 1 Hz – 400 KHz
1 CEPH Storage Cluster for o²S²PARC:
- *(3 nodes) each 64 core AMD 2.25 GHz, 256 GB RAM, 500 TB storage (total)*

1 Extension of o²S²PARC In-House Cluster:
- 2x 16 core AMD 4.3 GHz, 256 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks
- 2x 16 core AMD 3.4 GHz, 128 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks

1 TIP.ITIS.SWISS Mini Cluster:
- *(4 nodes) each 16 core AMD 3.4 GHz, 128 GB RAM, RTX 3060 GPU 12 GB, 3 TB disks*

CPU: 2 x 64 Core 3.1GHz Processor RAM: 1152GB DDR5 ECC
DISK: 2x3.84TB Enterprise SSD

Computers

75 Laptops (from Acer, Apple, Asus, Dell, HP, IBM, Lenovo)
83 Desktop Workstations (from HP, Dell, Acceleware, Dalco, custom built)
13 High Performance Computing Workstations/Servers (from Dalco, Acceleware, custom built)
7 QNAP Network Data Storage Servers
13 Dalco Servers
9 Miscellaneous Peripherals (network devices, printers, scanners, etc.)

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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 (ETH) Zurich, the global wireless communications industry, and several government agencies. IT'IS stands for "Information Technologies in Society".

Legal Status
The IT'IS Foundation is a non-profit, tax-exempt, independent research foundation.

Mission
The IT'IS Foundation is dedicated to expanding the scientific basis of the safe and beneficial application of electromagnetic energy in health and information technologies.

The IT'IS Foundation is committed to improving and advancing precision medicine and the quality of life of people with disabilities through innovative research.

The IT'IS Foundation provides a proactive, creative, and innovative research environment for the cultivation of sound science and research, and education.

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