



ZHURICH med tech

In Silico **We Trust**

In Silico

The digital revolution is extending the frontiers of medicine and medical technology. Computer modeling and simulation (CM&S), or *in silico* technologies, merge computational tools with biology to intuitively, precisely, and reliably perform complex analyses of life sciences applications. With this emerging paradigm, experimental manipulations that are infeasible or prohibitively complex to conduct in real-life experiments can be created while maintaining superior experimental control: the perfect complement to *in vivo* and *in vitro* studies.

ZMT provides *in silico* solutions to the medical device and life sciences industries. Our comprehensive simulation platform, Sim4Life, provides a powerful 3D validated biological and anatomical modeling environment for optimizing the effectiveness and performance of medical devices, improving patient safety, and discovering potential new treatments. Built from the ground up, Sim4Life provides smooth and fully automated or customizable workflows for applications ranging from exploratory research and medical device development to regulatory documentation for clinical trials and device certification.

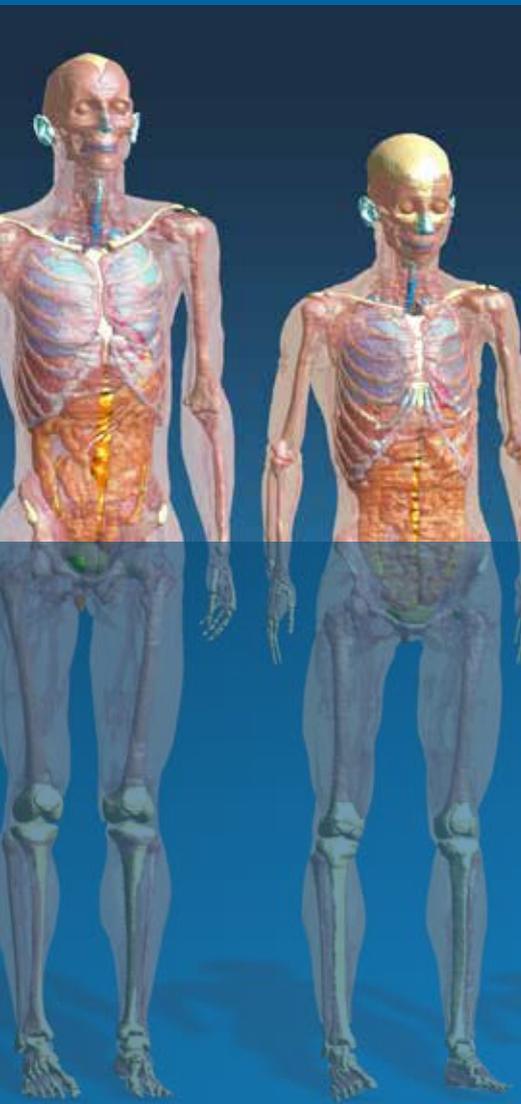
... we trust

Our software tools are thoroughly and continually verified to ensure their reliability and performance as they evolve.

We place high emphasis on the validation of our computable, functionalized models and medical device and life sciences applications.

ZMT also provides test systems for experimental validation procedures that support complex requirements with software tools optimized for test and measurement systems.

At ZMT, we leverage the combined strength of our expertise, experience, cost-effective solutions, and commitment to long and fruitful client relationships to guide you through the long and complex regulatory submission process.



Sim4Life Workflow

WORKFLOW

Posing
Segmentation
Morphing

CAD
Human Phantoms
Discretization

Multiphysics
High Performance
Solvers

Physiology
and Tissue
Models

Analysis
Visualization
Reports

OPEN SCRIPTABLE FRAMEWORK WITH A POWERFUL GRAPHICAL USER INTERFACE AND HIGH PERFORMANCE COMPUTING SUPPORT

Sim4Life is the first computational life sciences platform to integrate computable human phantoms with the most powerful physics solvers and the most advanced tissue models for directly analyzing biological real-world phenomena and complex technical devices in a 3D validated biological and anatomical environment.

All modeling capabilities from the segmentation of medical image data, anatomical and CAD model import, discretization, and simulation to visualization and analysis are embedded and streamlined to offer the most versatile and efficient simulation environment possible.

At the core of Sim4Life are the computable, high-fidelity 3D Virtual Population (ViP) human anatomical models. Carefully selected to fully represent global variability in human anatomy, the fully posable, morphable, and validated ViP models along with the IT'IS tissue properties database depict 15 different body types with 120 vital anatomical features and over 300 precisely identified tissues and organs.

Sim4Life is designed to simulate the most complex scenarios and all features have been thoroughly verified and validated to ensure the generation of results that accurately and reliably reflect reality and are ready for regulatory submissions.

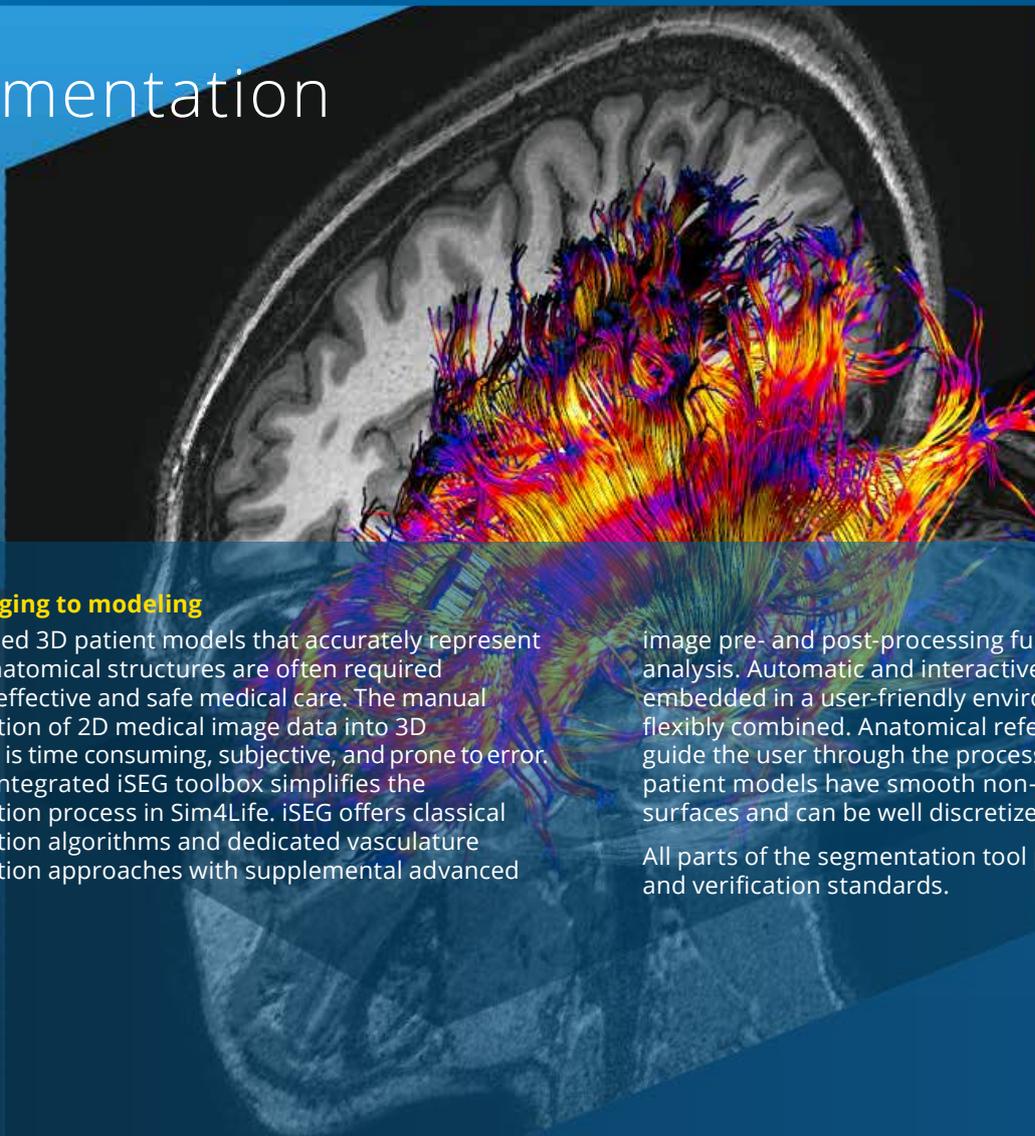
Segmentation

From imaging to modeling

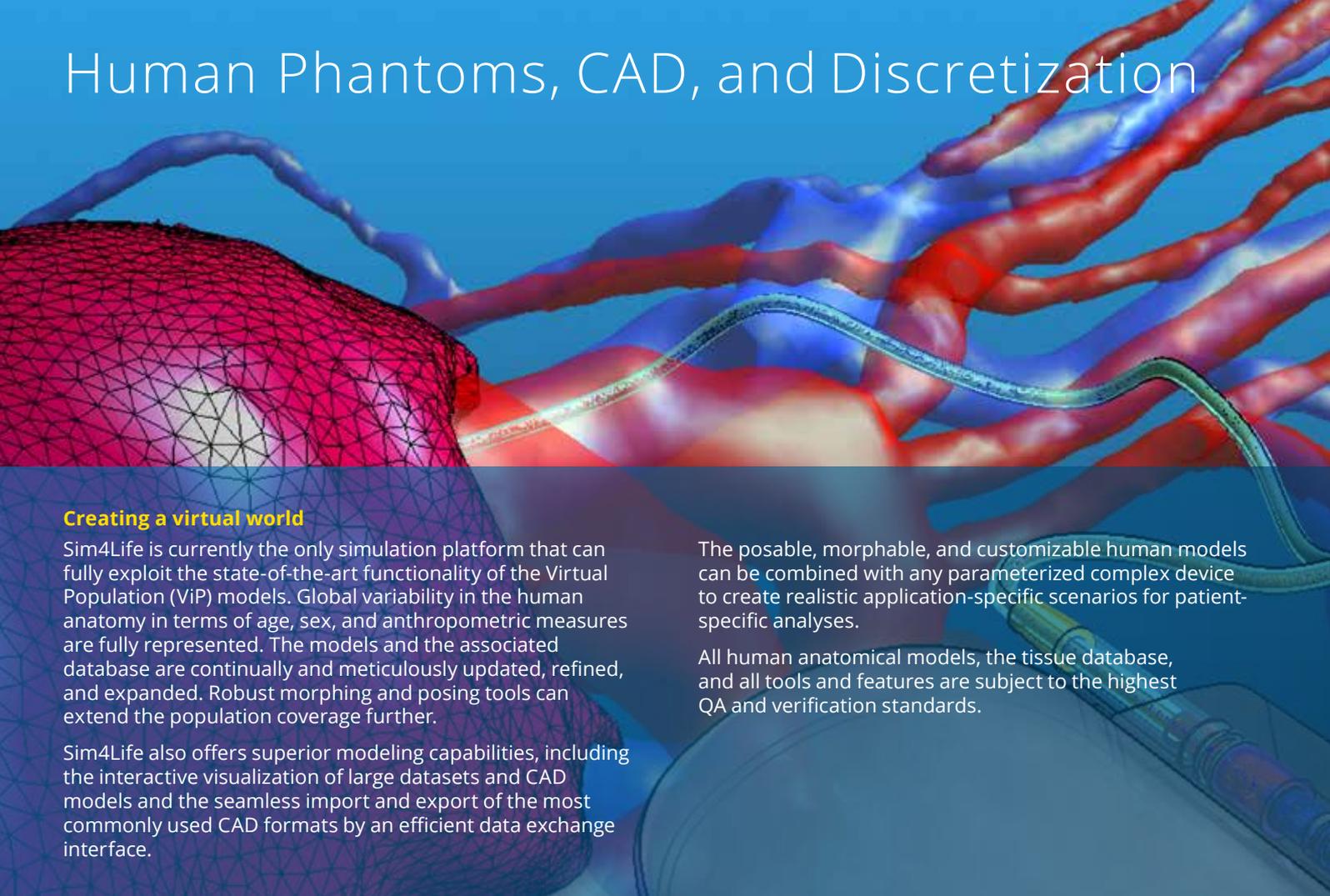
Personalized 3D patient models that accurately represent specific anatomical structures are often required to deliver effective and safe medical care. The manual segmentation of 2D medical image data into 3D structures is time consuming, subjective, and prone to error. The fully integrated iSEG toolbox simplifies the segmentation process in Sim4Life. iSEG offers classical segmentation algorithms and dedicated vasculature segmentation approaches with supplemental advanced

image pre- and post-processing functions and feature analysis. Automatic and interactive algorithms are embedded in a user-friendly environment and can be flexibly combined. Anatomical reference atlases guide the user through the process. The resulting 3D patient models have smooth non-intersecting surfaces and can be well discretized.

All parts of the segmentation tool pass the highest QA and verification standards.



Human Phantoms, CAD, and Discretization



Creating a virtual world

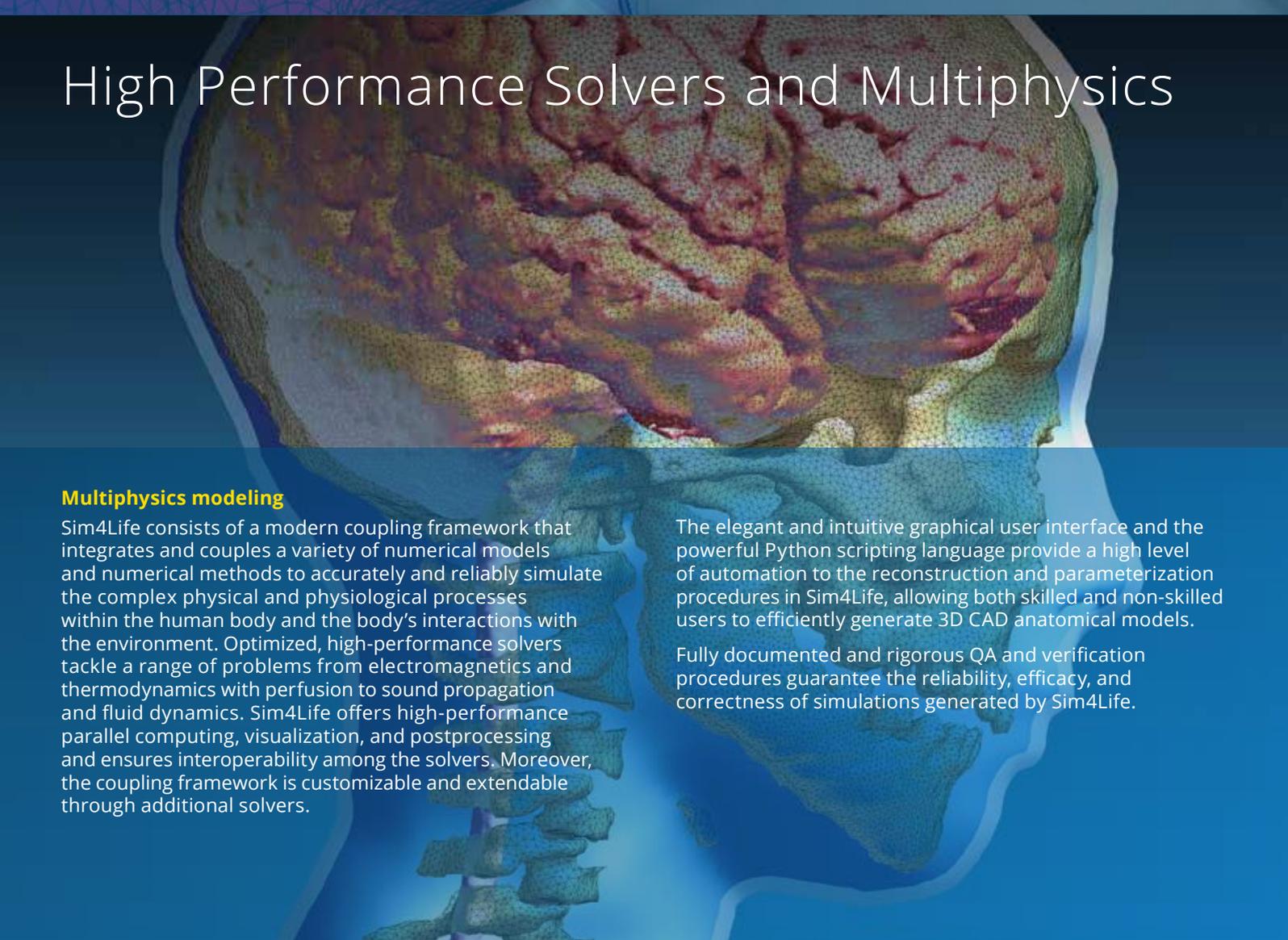
Sim4Life is currently the only simulation platform that can fully exploit the state-of-the-art functionality of the Virtual Population (ViP) models. Global variability in the human anatomy in terms of age, sex, and anthropometric measures are fully represented. The models and the associated database are continually and meticulously updated, refined, and expanded. Robust morphing and posing tools can extend the population coverage further.

Sim4Life also offers superior modeling capabilities, including the interactive visualization of large datasets and CAD models and the seamless import and export of the most commonly used CAD formats by an efficient data exchange interface.

The posable, morphable, and customizable human models can be combined with any parameterized complex device to create realistic application-specific scenarios for patient-specific analyses.

All human anatomical models, the tissue database, and all tools and features are subject to the highest QA and verification standards.

High Performance Solvers and Multiphysics



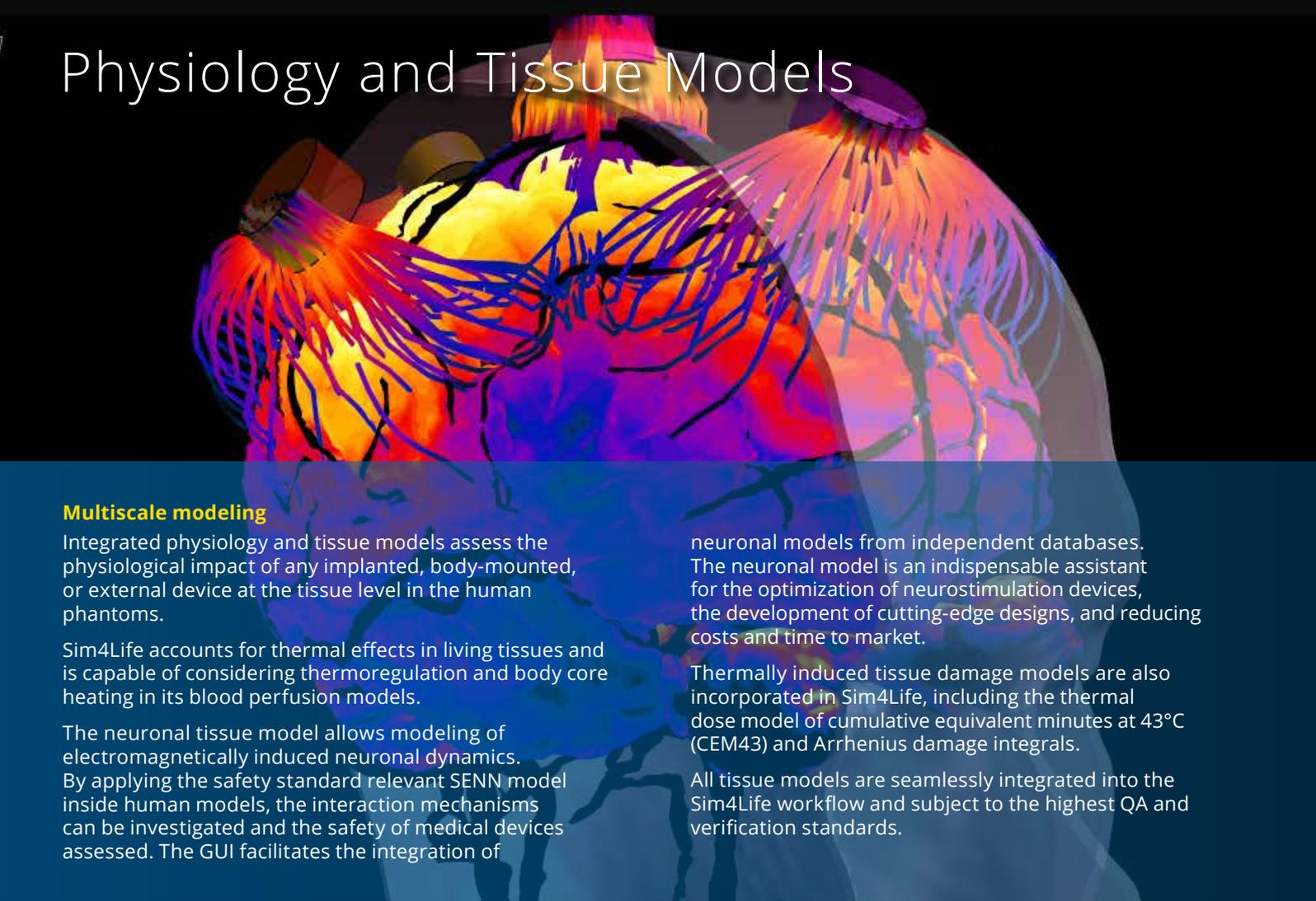
Multiphysics modeling

Sim4Life consists of a modern coupling framework that integrates and couples a variety of numerical models and numerical methods to accurately and reliably simulate the complex physical and physiological processes within the human body and the body's interactions with the environment. Optimized, high-performance solvers tackle a range of problems from electromagnetics and thermodynamics with perfusion to sound propagation and fluid dynamics. Sim4Life offers high-performance parallel computing, visualization, and postprocessing and ensures interoperability among the solvers. Moreover, the coupling framework is customizable and extendable through additional solvers.

The elegant and intuitive graphical user interface and the powerful Python scripting language provide a high level of automation to the reconstruction and parameterization procedures in Sim4Life, allowing both skilled and non-skilled users to efficiently generate 3D CAD anatomical models.

Fully documented and rigorous QA and verification procedures guarantee the reliability, efficacy, and correctness of simulations generated by Sim4Life.

Physiology and Tissue Models



Multiscale modeling

Integrated physiology and tissue models assess the physiological impact of any implanted, body-mounted, or external device at the tissue level in the human phantoms.

Sim4Life accounts for thermal effects in living tissues and is capable of considering thermoregulation and body core heating in its blood perfusion models.

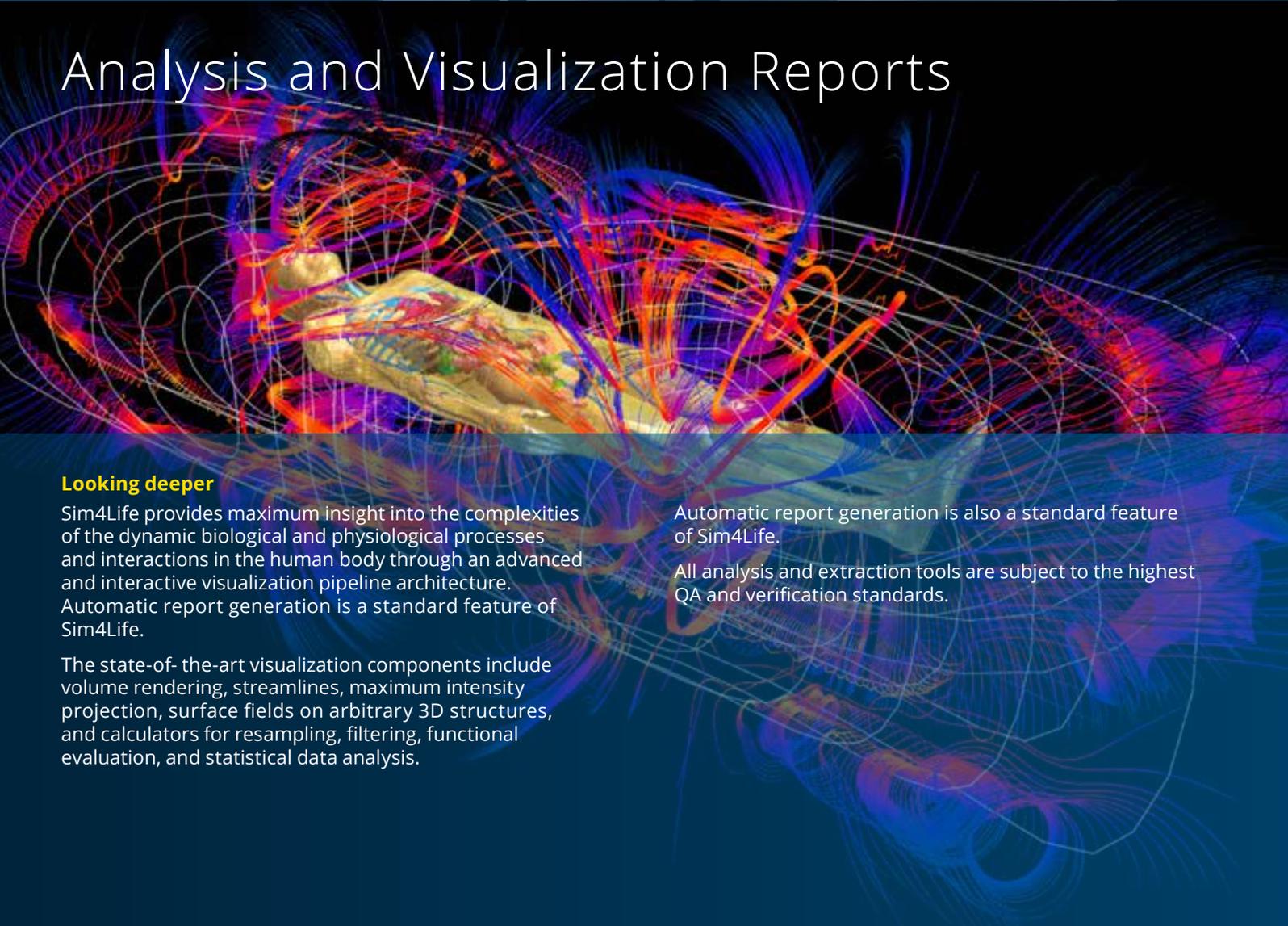
The neuronal tissue model allows modeling of electromagnetically induced neuronal dynamics. By applying the safety standard relevant SENN model inside human models, the interaction mechanisms can be investigated and the safety of medical devices assessed. The GUI facilitates the integration of

neuronal models from independent databases. The neuronal model is an indispensable assistant for the optimization of neurostimulation devices, the development of cutting-edge designs, and reducing costs and time to market.

Thermally induced tissue damage models are also incorporated in Sim4Life, including the thermal dose model of cumulative equivalent minutes at 43°C (CEM43) and Arrhenius damage integrals.

All tissue models are seamlessly integrated into the Sim4Life workflow and subject to the highest QA and verification standards.

Analysis and Visualization Reports



Looking deeper

Sim4Life provides maximum insight into the complexities of the dynamic biological and physiological processes and interactions in the human body through an advanced and interactive visualization pipeline architecture. Automatic report generation is a standard feature of Sim4Life.

The state-of-the-art visualization components include volume rendering, streamlines, maximum intensity projection, surface fields on arbitrary 3D structures, and calculators for resampling, filtering, functional evaluation, and statistical data analysis.

Automatic report generation is also a standard feature of Sim4Life.

All analysis and extraction tools are subject to the highest QA and verification standards.

Validation Hardware piX



piX System

Piecewise eXcitation System for RF-heating evaluations of active implanted medical devices in MRI environments

The piX system can generate a validated radio frequency (RF) model of any implant at 64 MHz or 128 MHz (other frequencies are available on request) within minutes. All instrumentation required for evaluation is included. The system fully complies with the Tier 3 procedure of the IEC/ISO TS10974 guidelines.

A variety of optimized piX Exciters are available for various frequencies and for a range of media to generate a local uniform tangential excitation of less than 10 mm. Crosstalk with the device under test at RF frequencies is eliminated by the Time Domain Sensor TDS.

MITS



MITS 1.5/3.0

Medical Implant Test Systems (MITS) for RF safety evaluations at 1.5 and 3.0 Tesla

MITS simulate high-precision incident fields with user-defined modulation and time sequences, as generated by commercial magnetic resonance scanners, and also enable worst-case incident field conditions. Optimized for testing implants and for validating implant RF models, both systems fully comply with all MRI implant safety standards, such as ASTM F 2182 and IEC/ISO TS10974.

The systems combine cutting-edge technology with accuracy, versatility, and user-friendliness, while the open user interface facilitates customized and automated evaluations.

Optional: ZMT offers additional metrology equipment from its sister company SPEAG. The robot-based scanning system DASY52 AIMD is fully supported for rapid and high precision SAR and temperature evaluations.

Applications List

Sim4Life provides a flexible, customizable, and extensible environment for a myriad of complex biomedical applications.

- **Magnetic resonance imaging**

- MRI scanning safety
- MRI sequence design and optimization
- MRI coil design
- MRI safety of active implanted medical devices (AIMD) and passive implants

- **Wireless communication and power transfer**

- Antenna design
- Dosimetry and safety standards with respect to neural stimulation and thermal doses
- Body area network design
- Communication with implanted medical devices
- Charging of implanted medical devices
- Wireless endoscopy

- **Neural stimulation**

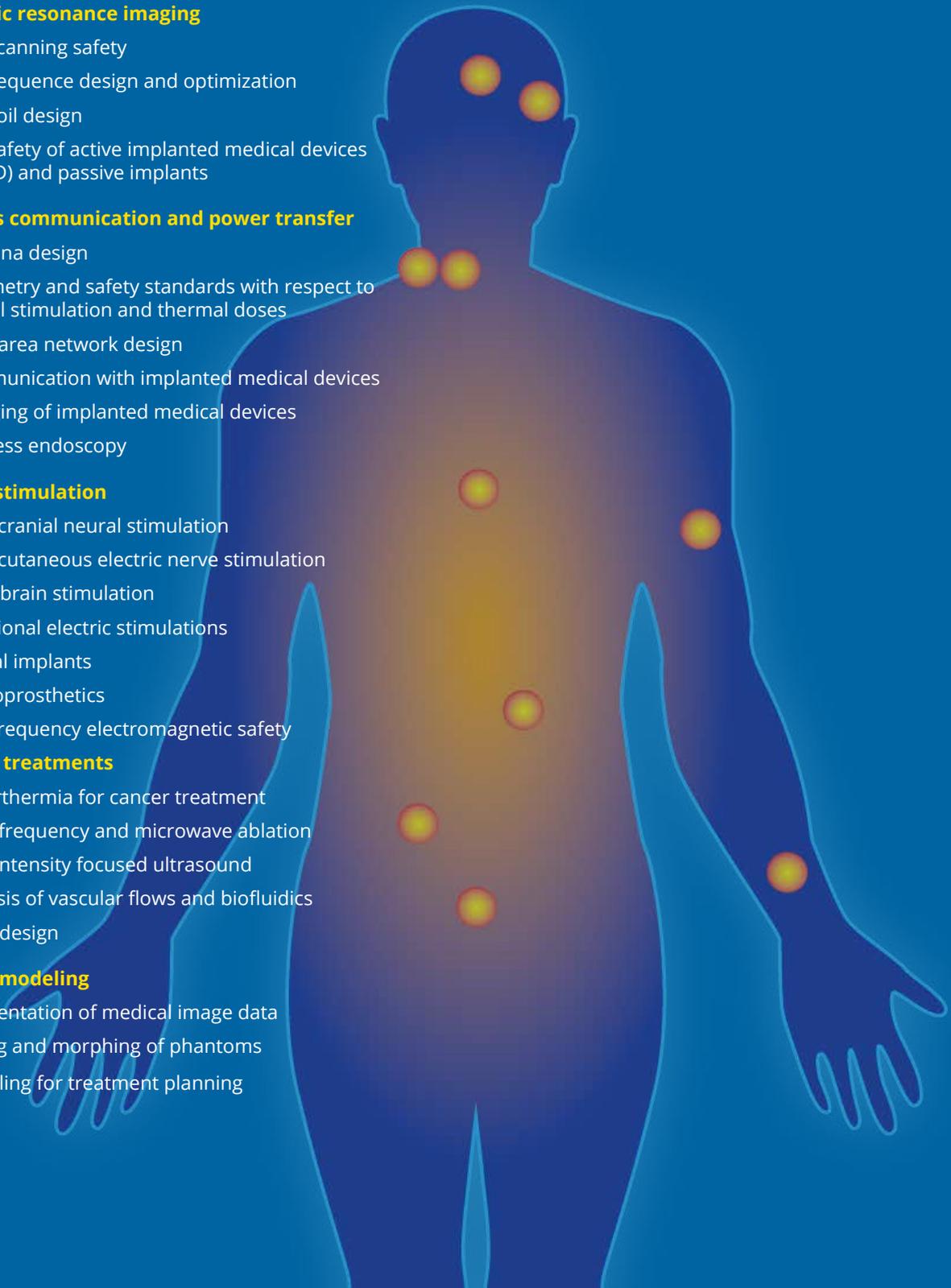
- Transcranial neural stimulation
- Transcutaneous electric nerve stimulation
- Deep brain stimulation
- Functional electric stimulations
- Neural implants
- Neuroprosthetics
- Low-frequency electromagnetic safety

- **Medical treatments**

- Hyperthermia for cancer treatment
- Radiofrequency and microwave ablation
- High intensity focused ultrasound
- Analysis of vascular flows and biofluidics
- Stent design

- **Human modeling**

- Segmentation of medical image data
- Posing and morphing of phantoms
- Modeling for treatment planning



About

ZMT is a member of the Zurich43 family, which includes the non-profit research institution the IT'IS Foundation as well as other commercial units SPEAG and Zeugi43, and the joint venture companies SCALK and BNNSPEAG. All enterprises are dedicated to the mission to expand the boundaries of methodologies, instrumentation, and computational tools for the accurate evaluation of electromagnetic (EM) near- and far-fields from static to optical frequencies and of complex technical medical devices in validated biological and anatomical environments. The family was established starting with SPEAG more than 20 years ago and expanded with the addition of the various entities in specialized disciplines.

ZMT Zurich MedTech AG (www.zurichmedtech.com)

ZMT was founded in 2006 as a spin-off company of the ETH and the IT'IS Foundation with the mission to develop tools and best practices for targeted life sciences applications for simulation, analysis, and prediction of complex and dynamic biological processes and interactions.

ZMT's flagship product is Sim4Life, a revolutionary simulation platform that combines computable human phantoms with incredibly powerful physics solvers and the most advanced tissue models. Sim4Life is used to analyze real-world biological phenomena and complex technical devices in validated computational biological and anatomical environments. ZMT provides fully characterized and ISO17025 calibrated experimental systems for the validation of *in silico* based evaluations. All systems are user friendly and seamlessly integrated with Sim4Life.

Schmid & Partner Engineering AG – SPEAG (www.speag.com)

SPEAG was founded in 1994 to develop and manufacture electromagnetic systems and components as a spin-off company of the Bioelectromagnetics/EM Compatibility group of the ETH Zurich (which later became the IT'IS Foundation). The cornerstone of SPEAG's success is its strong investment in R&D and its strategic alliances with leading research institutions to ensure the development of cutting-edge products. Key products are DASY6, cSAR3D, ICEy/TDS, DAK, EM Phantoms, EM Probes for measurements from DC to 100 GHz, and SEMCAD X.

To better serve its customers and those of ZMT and the IT'IS Foundation, a calibration laboratory certified by the Swiss Accreditation Service (SAS) for ISO/IEC 17025 Accreditation and multilaterally recognized by EA, IFA, and ILAC was established in 2001. The laboratory provides extensive calibration services to the entire Zurich43 family for systems, probes, antennas, dielectric probe kits, phantoms, materials, etc.

To bring services closer to SPEAG's global customer base, a number of satellite facilities were co-founded: the SPEAG Calibration Laboratory Korea together with DYMSTEC in 2011, and the BNNSPEAG Test & Calibration Laboratory India together with BNN Communication Engineers in 2012.

Foundation for Research on Information Technologies in Society – IT'IS Foundation (www.itis.ethz.ch)

The IT'IS Foundation was established in 1999 through the initiative and with the support of the ETH Zurich, the global wireless communications industry, together with several governmental agencies. It is the leading independent non-profit research foundation dedicated to improving and advancing the quality of people's lives by advancing personalized medicine and computational life sciences (IT'IS for Health) and beneficial applications of EM energy and wireless communications (EM Research). The IT'IS Foundation provides an innovative proactive and interdisciplinary research environment for the cultivation of sound science and research and good education. Results are widely disseminated to the scientific community and the public through peer-reviewed journal articles, conference proceedings, television interviews, and white papers. IT'IS also supports the R&D efforts of industrial partners, in particular SME's such as SPEAG and ZMT, to advance precompetitive and noncompetitive research initiatives.

Zeugi43 AG

Zeugi43 AG was founded in 2009 with the objective to provide the best possible infrastructure for the members of the Zurich43 family at its headquarters in downtown Zurich.

Regional Sales Channels and Partners

A complete list of local sales channels and partners can be found at our website.

