



# In Silico Oncology and In Silico Medicine Group

Institute of Communication and Computer Systems  
School of Electrical and Computer Engineering  
National Technical University of Athens

<https://www.in-silico-oncology.iccs.ntua.gr/>

Director: Research Professor Georgios S. Stamatakos

## A BRIEF INTRODUCTORY PRESENTATION

April 2021

## Director

### *Research Professor Georgios Stamatakos*

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*School of Electrical and Computer Engineering (SECE)*

*National Technical University of Athens (NTUA)*

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*Visiting Professor, Medical School, University of Saarland, Germany (1/7– 15/9/2019)*

*Visiting Professor, SECE, NTUA (2016-2019)*

*(<https://www.in-silico-oncology.iccs.ntua.gr/georgios-stamatakos> )*

# MAJOR EXPERTISE OF THE GROUP

- **Artificial Intelligence (AI)** for Medicine, Biology, Social Sciences (Psychology, Demographics etc.) and Related Fields
- **Mechanistic Multiscale Modelling (MMM)** for Medicine, Biology and Related Fields (Ordinary and Partial Differential Equations, Discrete Mathematics, Hybrid Mathematical Approaches (MMM & AI) etc.)
- **Statistics** for Medicine, Biology, Social Sciences and Related Fields
- **Software Engineering** (Model Repositories, Module Integration for Digital Twins etc.)
- **Other Domains** (Computational Electromagnetics, Computational Optics, Bioelectromagnetics, Biooptics, Non Ionizing Radiation Safety)
- **Broad Dissemination Activities** (through several channels such as the Virtual Physiological Human Institute)

# OUR VISION AND MISSION

(1/2)

- In Silico Oncology and In Silico Medicine Group (ISO&ISM\_G), Institute of Communication and Computer Systems (ICCS), School of Electrical and Computer Engineering (SECE), National Technical University of Athens (NTUA) **is dedicated to the shaping, the advancement and the clinical translation of the new scientific and technological domain of in silico (computational) oncology and more broadly in silico medicine.** It is worth noting that the contribution of ISO&ISM\_G to the genesis and the shaping of in silico medicine has been **pivotal**. It actually started before 2002 ([https://en.wikipedia.org/wiki/In\\_silico\\_medicine](https://en.wikipedia.org/wiki/In_silico_medicine), section History). Furthermore, the “Oncosimulator” has been the first digital twin in oncology ( a “**world first**”) (<https://cordis.europa.eu/article/id/86061-project-success-stories-in-silico-medicine-reaches-the-clinic> )
- All major scientific and technological pylons of contemporary in silico medicine i.e. **mechanistic multiscale modelling, artificial intelligence** (machine learning), **biostatistics** and **software engineering** as well as their combinations are extensively addressed by the group.

# OUR VISION AND MISSION

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- A long series of **diverse clinical questions and problems** have been dealt with. These include inter alia patient individualized optimization of treatment through in silico experimentation, in silico clinical studies/trials, prediction of patient resilience trajectories, statistical and artificial intelligence analysis of the interrelations of multiscale, multidomain and multidisciplinary parameters of clinical importance and suggestions for clinical interventions.
- Several **complex diseases**, including **many cancer types**, and treatment modalities have been and are being addressed.
- Research is conducted within the framework of an excellent EU-US fundamental science, technological, clinical, industrial and legal-ethical **network**.
- **Education** in the fields of multiscale cancer modelling and in silico medicine is a further important activity of ISO&ISM\_G. It is worth noting that the doctoral course No 705 of SECE, NTUA entitled “Multiscale Cancer Modelling and In Silico Medicine” proved to be **the first postgraduate course** on an international scale specifically **dedicated to in silico medicine** (<https://www.vph-institute.org/news/new-postgraduate-subject-on-multiscale-cancer-modelling-and-in-silico-medicine-mscm-ism.html> ). The written material of the course (mostly in English) along with its video recordings (mostly in Greek) can be accessed via the link [http://mycourses.ntua.gr/course\\_description/index.php?cidReq=ECE1406](http://mycourses.ntua.gr/course_description/index.php?cidReq=ECE1406) . Access to the written material is open to anyone. For access to the video recordings by persons outside NTUA a permission request is needed (instructions are provided through the previous link).

# A STRATEGIC CLINICAL COLLABORATION

- A strategic and exceptionally fruitful **clinical collaboration** of ISO&ISM\_G with the Paediatric Oncology and Haematology Clinic, Medical School, University of Saarland, Germany (Director: Prof. Norbert Graf) has been established since 2004. Of paramount importance is the fact that Prof. Norbert Graf is the Chairman of the Renal Study Group of the International Society of Pediatric Oncology (SIOP-RTSG).
- It is noted that **nephroblastoma (Wilms tumour)**, which is the most common type of renal (kidney) cancer in children, has been and is being addressed by the ISO&ISM\_G in a very special way. The obvious reason for this is that both globally top clinical guidance and high quality multiscale data sets for the particular tumour type have been and are being provided by Prof. Graf for the particularly demanding needs of the development and the clinical adaptation and validation of the multiscale mechanistic Nephroblastoma Oncosimulator. It is pointed out that the Nephroblastoma Oncosimulator, apart from its obvious goal regarding the patient individualized treatment optimization of the particular tumour, is viewed as a model or prototype for the shaping, development and validation of Onsosimulators addressing other tumour types.

# RESEARCH PROJECTS (Selected)

(1/3)

- **PersoRad: Implementation of mobile health tools and artificial intelligence for personalised radiation treatment planning and monitoring in prostate cancer**". Funded by the European Commission and Member States. Reference Number: ERAPERMED2019-299. Duration 01/04/2020 - 31/03/2023. EC Project Website: <https://www.era-learn.eu/network-information/networks/era-permed/personalised-medicine-multidisciplinary-research-towards-implementation/implementation-of-mobile-health-tools-and-artificial-intelligence-for-personalised-radiation-treatment-planning-and-monitoring-in-prostate-cancer>. ISO&ISM\_G is developing inter alia the mechanistic multiscale simulation model of prostate cancer and its response to treatment to be combined with the artificial intelligence modules of the project.
- **BOUNCE: Predicting Effective Adaptation to Breast Cancer to Help Women to BOUNCE Back**. Funded by the European Commission (GA number: 777167, <https://www.bounce-project.eu/>). Duration: 4.5 years. Start Date: 1 Nov, 2017. G. Stamatakos, ISO&ISM\_G is the Leader of the workpackage on in silico modelling via artificial intelligence and biostatistics.
- **CHIC: Computational Horizons in Cancer - Developing Meta- and Hyper-Multiscale Models and Repositories for In Silico Oncology**. A large scale EU-US transatlantic research project funded by the European Commission (Grant Agreement No 600841, <http://www.chic-vph.eu/>) with 10,582,000 €. G. Stamatakos, ISO&ISM\_G was the Scientific and the Overall Coordinator of CHIC. In its final review CHIC was rated as “**Excellent**” by the European Commission whereas its outcome was designated as “**great achievements**” (<https://digital-strategy.ec.europa.eu/en/news/great-achievements-eu-funded-chic-project> )

# RESEARCH PROJECTS (Selected)

(2/3)

- **DR THERAPAT - The Digital Radiation Therapy Patient.** Funded by the European Commission ([https://cordis.europa.eu/project/rcn/106627\\_en.html](https://cordis.europa.eu/project/rcn/106627_en.html), <http://drtherapat.eu/> , FP7/2007-2013, Grant no 270089). G. Stamatakos, ISO&ISM\_G was the leader of workpackage WP5 entitled: “Biological and biophysical multi-scale modeling.”
- **MyHealthAvatar - "A Demonstration of 4D Digital Avatar Infrastructure for Access of Complete Patient Information "** Funded by the European Commission (Grant Agreement: 600929, <http://www.myhealthavatar.eu/>). G. Stamatakos ISO&ISM\_G was the Leader of WP5 (Models & Repositories) and WP 10 (Dissemination and Exploitation)
- **P-MEDICINE: From Data Sharing and Integration via VPH Models to Personalized Medicine.** Funded by the European Commission (FP7-ICT- 2009-6-270089). G. Stamatakos, ISO&ISM\_G was the leader of workpackage WP12 entitled: “VPH Modelling and the Integrated Oncosimulator”.
- **TUMOR: Transatlantic Tumor Model Repositories** (FP7-ICT-2009-5-247754, [http://cordis.europa.eu/project/rcn/93722\\_en.html](http://cordis.europa.eu/project/rcn/93722_en.html)). Funded by the European Commission. G. Stamatakos, ISO&ISM\_G was the leader of workpackage WP3 entitled: “EU Model Repository Implementation and Adaptation of EU-US Models Addressing Clinical Scenarios”.



# RESEARCH PROJECTS (Selected)

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- **CONTRA CANCRUM: Clinically Oriented Translational Cancer Multilevel Modelling.** Funded by the European Commission (Project ID: 223979, [https://cordis.europa.eu/project/rcn/87306\\_en.html](https://cordis.europa.eu/project/rcn/87306_en.html) , <https://www.contracancrum.eu/>) . G. Stamatakos, ISO&ISM\_G was the leader of workpackages WP4 and WP8 entitled: "Simulation at the Cellular and Higher Levels of Biocomplexity" and "Integration of the Simulation System" respectively
- **ACGT: Advancing Clinico-Genomic Clinical Trials on Cancer.** Funded by the European Commission and Japan (FP6-2005-IST-026996, <http://acgt.ercim.eu/acgt-for-you/researchers/in-silico-oncology.html>, <http://acgt.ercim.eu/>) G. Stamatakos, ISO&ISM\_G was leader of workpackage WP8 entitled: "Technologies and Tools for In Silico Oncology"
- **CViT: Center for the Development of a Virtual Tumor (CViT).** Funded by the United States of America (National Cancer Institute (NCI) Grant CA113004) from 2004 till 2011 and led by Massachusetts General Hospital in collaboration with Harvard Medical School and Massachusetts Institute of Technology. G. Stamatakos, ISO&ISM\_G was a member of the CViT virtual organization and recipient of mini travelling grants from NCI and the National Science Foundation (NSF).
- **Development and Adaptation of an In Silico Oncology Application in a Grid Environment** (in Greek), Funded by the Greek Secretariat for Research and Technology (Project code: 05GRID41) Duration: 12 months (1 Jan 2007 till 31 Dec. 2007).

# RESEARCH PUBLICATIONS

- Books, book chapters, journal and conference papers as well as broad public articles can be found at <https://www.in-silico-oncology.iccs.ntua.gr/projects-1> and <https://www.researchgate.net/profile/Georgios-Stamatakos/research>

# AN EXEMPLARY RECENT EXCELLENT INNOVATION

(1/2)

BREAST CANCER

EUROPEAN COMMISSION - An excellent innovation: "In silico tool for predicting resilience in women diagnosed with breast cancer" ( [CNECT-INNOVATION-RADAR@ec.europa.eu](mailto:CNECT-INNOVATION-RADAR@ec.europa.eu) )

A key Innovator: Institute of Communication and Computer Systems (ICCS), School of Electrical and Computer Engineering (SECE), National Technical University of Athens (NTUA), In Silico Oncology and In Silico Medicine Group ( <https://lnkd.in/ejrd-zc> )

The innovation has been based on multiscale and multidisciplinary clinical, biological, psychological, functional and societal data produced by the BOUNCE project prospective clinical study in conjunction with sophisticated artificial intelligence (AI) and advanced biostatistics approaches. The BOUNCE project website is accessible at <https://lnkd.in/edpgVmc> .

# AN EXEMPLARY RECENT EXCELLENT INNOVATION

(2/2)

A practical use of the predictive models is to prescribe adequate and timely interventions (e.g. psychological support) following breast cancer treatment, if and when this is predicted to be necessary.

The action (workpackage) of the BOUNCE project entitled "Development of the Predictive Breast Cancer Resilience Computer Models" is led by Research Professor G. S. Stamatakos, ICCS, SECE, NTUA and Member of the Board of Trustees, Virtual Physiological Human Institute (VPHi, [https://lnkd.in/eTT9\\_7G](https://lnkd.in/eTT9_7G) )

<https://www.linkedin.com/feed/update/urn:li:activity:6783779040621862912/>

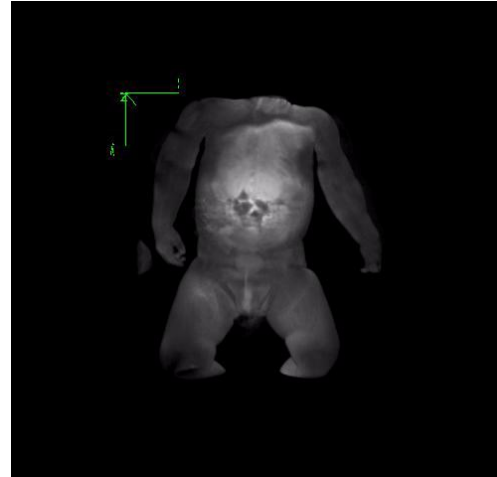
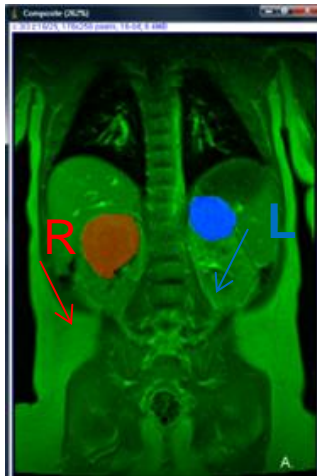
# A MECHANISTIC MULTISCALE CANCER MODELLING EXAMPLE

(see the next two pages)

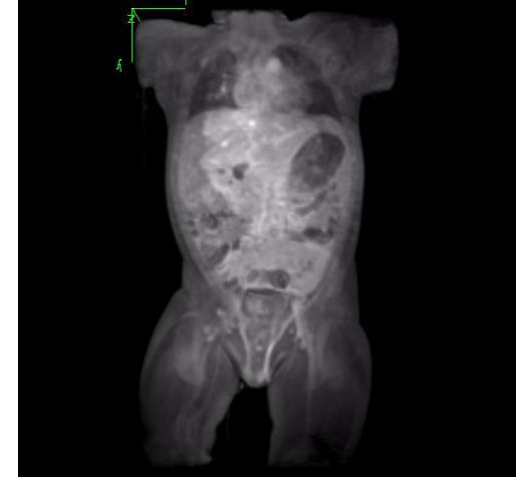
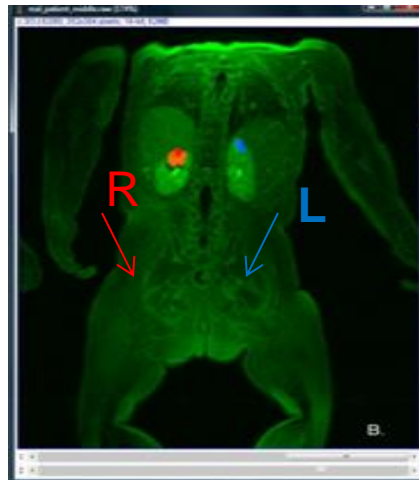
# Nephroblastoma tumor (bilateral case) under neoadjuvant chemotherapeutic treatment. Imaging data (ISOG&ISM\_G and University Hospital of Saarland – Paediatric Oncology and Haematology Clinic).



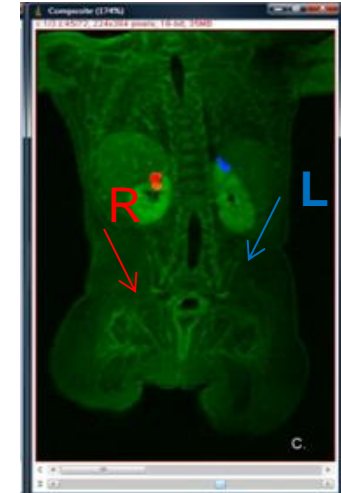
**1<sup>st</sup> Imaging Set (IS)**



**2<sup>nd</sup> Imaging Set**



**3<sup>rd</sup> Imaging Set**

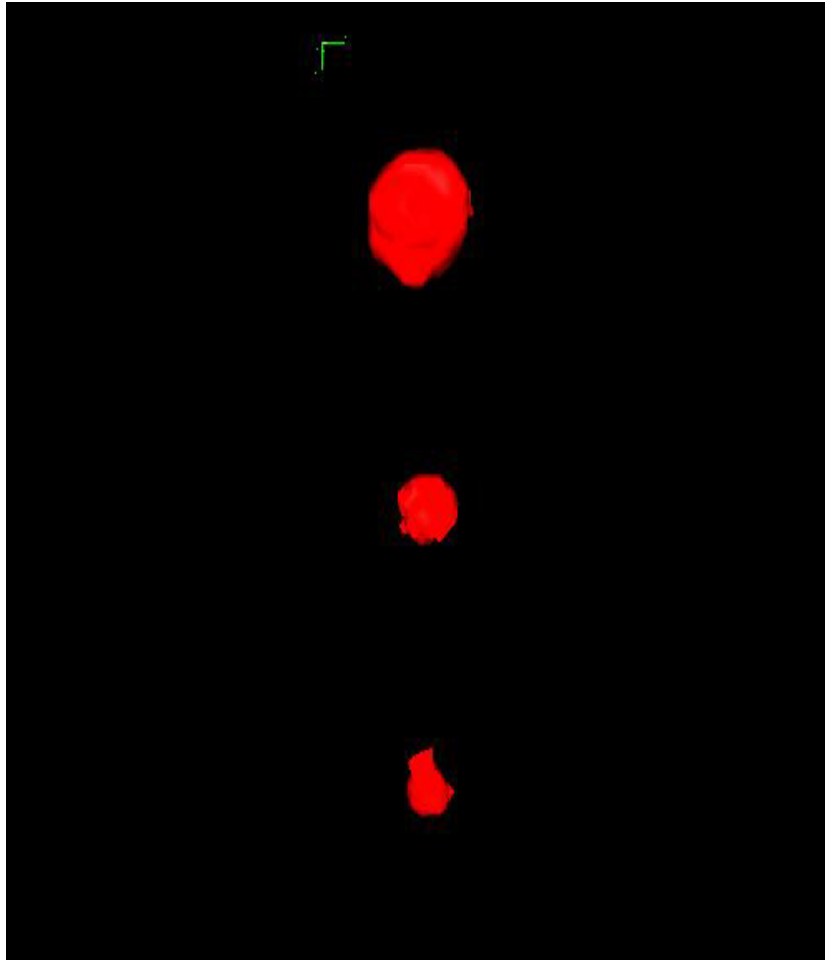


# Nephroblastoma tumor (bilateral case) under neoadjuvant chemotherapeutic treatment. Simulation predictions (The Nephroblastoma Oncosimulator) .

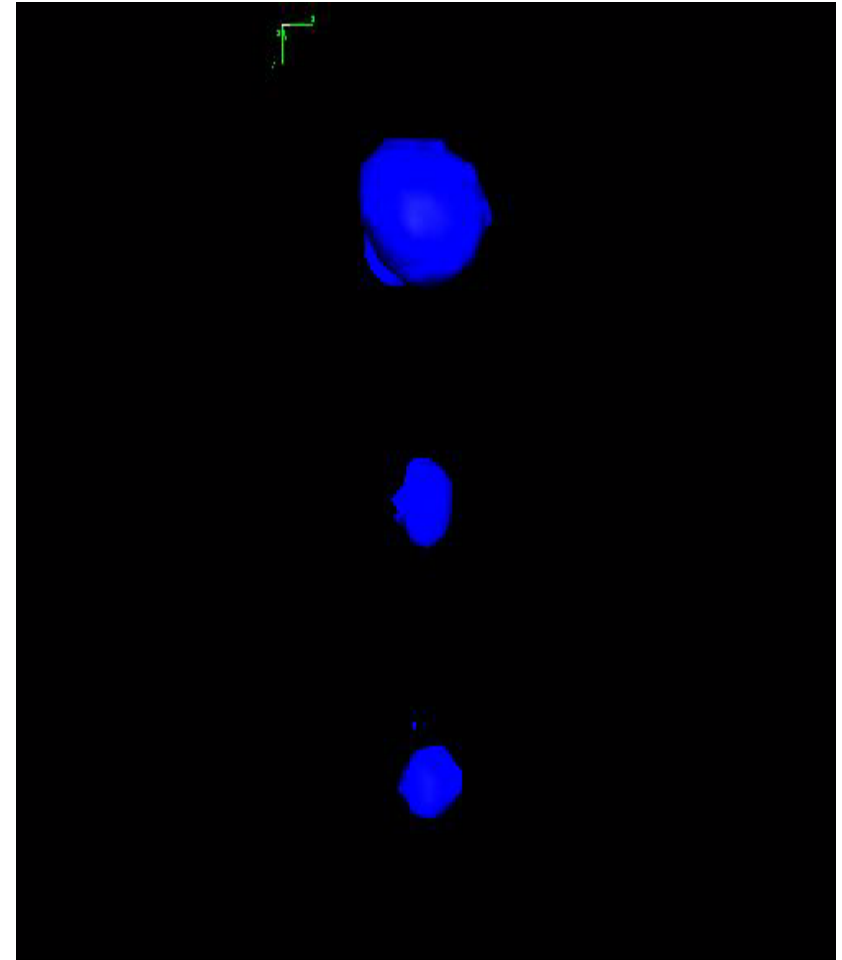
**1<sup>st</sup> I.S.  
time-  
point**

**2<sup>nd</sup> I.S.  
time-  
point**

**3<sup>rd</sup> I.S.  
time-  
point**



**Right Kidney**



**Left Kidney**

**Thank you**