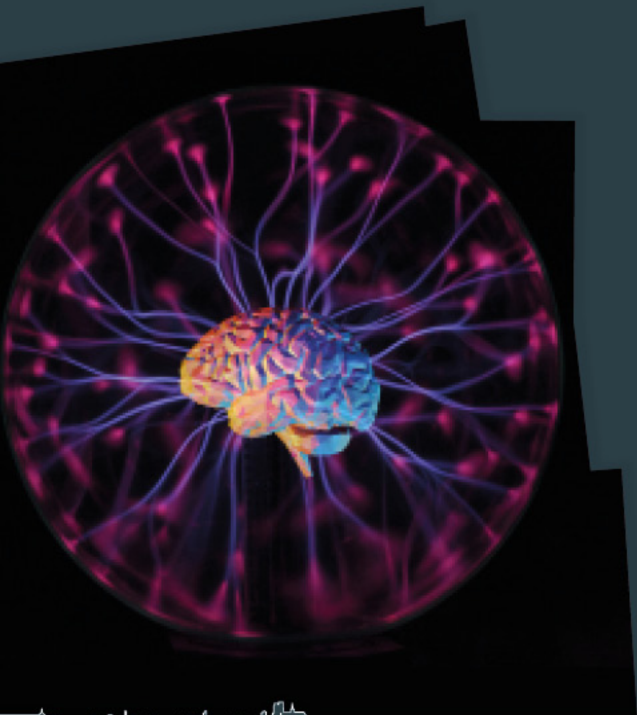
LE STUDIUM
CONFERENCES
VIRTUAL MEETING | 2022

29 & 30 November 2022

On-line Meeting on Artificial Intelligence for Plasma Science



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LOCATION

VIRTUAL MEETING

CONVENORS

Prof. Feng Huang
LE STUDIUM GUEST RESEARCH FELLOW

FROM China Agricultural University, Beijing - CN
IN RESIDENCE AT Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

Dr Eric Robert
Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

Dr Augusto Stancampiano
Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

PROGRAMME - REGISTRATION

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LE STUDIUM
Loire Valley Institute for Advanced Studies

LE STUDIUM

CONFERENCES

VIRTUAL MEETING | 29 & 30 NOVEMBER 2022

ABSTRACTS

On-line Meeting on Artificial Intelligence for Plasma Science

CONVENORS

Prof. Feng Huang
LE STUDIUM GUEST RESEARCH FELLOW
FROM: China Agricultural University, Beijing - CN
IN RESIDENCE AT: Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

Dr Eric Robert
Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

Dr Augusto Stancampiano
Research Group in the Energetics of Ionized Media (GREMI) / CNRS, University of Orléans - FR

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Prof. Ali Mesbah
College of Chemistry, UC Berkeley - USA

Prof. Nevena Puach
Institute of Physics Belgrade - RS

ORGANIZING COMMITTEE

Sophie Gabillet, General Secretary

Dr Aurélien Montagu, Scientific Manager

Maurine Villiers, Communication & Events Manager

LE STUDIUM Loire Valley Institute for Advanced Studies • Région Centre-Val de Loire • FR

EDITO

Created in 1996 on the CNRS campus in Orleans La Source, LE STUDIUM has evolved to become the multidisciplinary Loire Valley Institute for Advanced Studies (IAS), operating in the Centre-Val de Loire region of France. LE STUDIUM has its headquarters in the city centre of Orleans in a newly renovated 17th century building. The amazing facilities are shared with the University of Orleans. In 2014 new developments and programmes linked to the smart specialisation of the Centre-Val de Loire region came to strengthen existing IAS collaborative relationships with the local and the international community of researchers, developers and innovators.

LE STUDIUM IAS offers to internationally competitive senior research scientists the opportunity to discover and work in one of the IAS's affiliate laboratories from the University of Tours, the University of Orleans, National Institute of Applied Sciences (INSA) Centre Val de Loire and ESAD Orléans, as well as of nationally accredited research institutions located in the region Centre-Val de Loire (BRGM, CEA, CNRS, INSERM, INRAE). Our goal is to develop and nurture trans-disciplinary approaches as innovative tools for addressing some of the key scientific, socio-economic and cultural questions of the 21st century. We also encourage researchers' interactions with industry via the IAS's links with Poles of Competitiveness, Clusters, Technopoles, and Chambers of Commerce etc.

LE STUDIUM has attracted near two hundred and fifty experienced researchers coming from 47 countries for long-term residencies. In addition to their contribution in their host laboratories, researchers participate in the scientific life of the IAS through attendance at monthly interdisciplinary meetings called LE STUDIUM THURSDAYS. Their presentations and debates enrich the regional scientific community at large (researchers of public and private laboratories, PhD students, research stakeholders' representatives, etc...)

For the period 2015-2021, LE STUDIUM has operated with an award from the European Commission, a programme supporting the mobility of international researchers, the Marie Skłodowska-Curie Actions (MSCA) COFUND programme. For the period 2022-2025, LE STUDIUM has joined the FIAS Programme (French Institute for Advanced Study) along side five other institutes in France, also supported by the MSCA Actions. Since 2013, LE STUDIUM is also an official partner of the Ambition Research and Development programmes initiated by the Centre-Val de Loire Regional Council to support the smart specialisation strategy (S3) around priority domains: biopharmaceuticals, renewable energies, cosmetics, environmental metrology, digital twins, materials, forestry and natural and cultural heritage. Furthermore our current collaboration with the ATHENA European University Consortium allows us to welcome fellows from ten European partners universities. New programmes are currently designed to include all major societal challenges.

Researchers are also invited and supported by the IAS to organise, during their residency and in collaboration with their host laboratory, a two-day LE STUDIUM CONFERENCE. It provides them with the opportunity to invite internationally renowned researchers to a cross-disciplinary conference, on a topical issue, to examine progress, discuss future studies and strategies to stimulate advances and practical applications in the chosen field. The invited participants are expected to attend for the duration of the conference and contribute to the intellectual exchange. Past experience has shown that these conditions facilitate the development or extension of existing collaborations and enable the creation of productive new research networks.

The present LE STUDIUM CONFERENCE named "*On-line Meeting on Artificial Intelligence for Plasma Science*" is the 123rd in a series started at the end of 2010 listed at the end of this booklet.

We thank you for your participation and wish you an interesting and intellectually stimulating conference. Also, we hope that scientific exchanges and interactions taking place during this conference will bring opportunities to start a productive professional relationship with presenting research laboratories and LE STUDIUM Loire Valley Institute for Advanced Studies.

Yves-Michel GINOT

Chairman
LE STUDIUM

INTRODUCTION

This first On-line Meeting on Artificial Intelligence for Plasma Science will gather together experts from artificial intelligence and plasma communities. The objectives are to:

- Introduce some basics on AI and machine learning strategies for Plasma Science
- Exemplify on the first demonstrations on the use of AI in plasma science. Here Plasma Science encompasses among others: plasma processing, plasma medicine, plasma agriculture, plasma device control and monitoring, plasma diagnostics, ...
- Develop an interdisciplinary international researcher network on Artificial Intelligence for Plasma Science

PROGRAMME

TUESDAY NOVEMBER 29TH, 2022 (PARIS TIME, GMT +1)

Chairwoman: Prof. Cristina Canal

13:00 Welcome / Introduction: "What is plasma in 600 seconds ?"

13:15 Prof. Marcilio De Souto - Introduction to Artificial Intelligence with Machine Learning Techniques

14:00 Prof. Xin Tu - Machine learning for the optimization of plasma chemical processes

14:25 Prof. Sylwia Ptasinska - Revealing low-temperature plasma efficacy through a dose-rate assessment machine learning framework

14:50 Dr Utku Kürşat Ercan - How Can Artificial Intelligence Contribute to Plasma Medicine Towards Clinical Use?

15:15 Short break

Chairman: Dr Augusto Stancampiano

15:25 Sophie Gabillet (General Secretary) **-** Presentation of LE STUDIUM

15:35 Virginie Le Tallec - Presentation of ATHENA (European University in Orleans)

15:45 Dr Markus Becker- INPTDAT, a FAIR data platform for applied plasma science

16:10 Dr Tommaso Gallingani - Optimal experimental design for plasma processes investigation and tuning: a multi objective and multi fidelity approach

16:35 Luigi Salazar - Spectral modes extraction using Signal Processing and Artificial Intelligence techniques based on reflectometry data

17:00 Dr Bhaskar Chaudhury - Deep Learning for Extracting Electron Scattering Cross Sections from Swarm Data

17:25 Sarah Chouchene - Detection of Plasma Turbulence in Plasma Fusion Devices Using Ultra-Fast Camera and Artificial Intelligence

WEDNESDAY NOVEMBER 30TH, 2022 (PARIS TIME, GMT +1)

Chairman: Dr Eric Robert

13:00 Prof. Jalal Fadili - AI for Science, Science for AI

13:20 Prof. Satoshi Hamagushi - Introduction to data science applied to plasma science and technologies

SPECIAL SESSION ON AI FOR PLASMA SCIENCE AT CAU IN PROF. HUANG'S GROUP

14:05 Prof. Feng Huang - Short introduction on Plasma Agriculture and Science including AI approaches

14:15 Dr Xiaojiang Tang - An MLP Network Based on Residual Learning for Plasma Rice Recognition

14:35 Dr Wenzhuo Chen - Shortcut improved Convolutional Network Application in Plasma-treated Rice Growth Classification

14:55 Dr Boaxia Li - Deep Learning Application in Complex Plasma Image Recognition

15:15 *Short break*

Chairwoman: Prof. Nevena Puac

15:35 Prof. Ali Mesbah - A Tutorial on Bayesian Optimization for Design of Experiments for Low-Temperature Plasmas

16:20 Sara Emadi - structure-independent Prediction of the BM-MSC response to CAP treatment using machine learning algorithms based on plasma emission Spectrometry

16:45 Mehmet Akif Özdemir - Can Machine Learning Predict the Antimicrobial Activity of Cold Atmospheric Plasma-Activated Liquids?

17:10 Gizem Dilara Özdemir - Prediction of Oxidative Strength of Cold Atmospheric Plasma Activated Water via Paper-Based Sensor: A Machine Learning Approach

17:25 Conclusion & perspectives

ATHENA EUROPEAN UNIVERSITY

Advanced Technology Higher Education Network Alliance – the ATHENA European University is a federation of mid-size higher education institutions in nine European countries. It draws on their combined strengths to reach a common objective: deliver high-quality education with a positive impact on research, youth employability and social advancement at the national and European levels.

"We aim to deliver inclusive, innovative,
high quality international education
permanently aligned with global market needs"

The network's educational and research priorities will be informed by and aligned with the respective European priorities and needs. The introduction of joint multidisciplinary modules and curricula, supported by blended and actual mobility schemes, will break down any possible scientific and cultural barriers to mobility.

Our Vision

ATHENA will deliver inclusive, innovative, high-quality international education permanently aligned with global market needs, addressing societal and environmental challenges as well as European research priorities, thus granting the highest employability standards, effective career transitions to our students and added value to our ecosystem.

Our Mission

With a strong focus on research and education in the fields of science, technology and engineering ATHENA aims at accompanying and shaping the digital transformation of societies, and will thus support the development of an inclusive, sustainable and safe digital economy.

Key Objective

To deliver inclusive, innovative, high-quality international education permanently aligned with global market needs.

ATHENA
EUROPEAN UNIVERSITY

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CONVENORS

SPEAKERS

CONVENORS

Prof. Feng Huang

LE STUDIUM Guest Research Fellow

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Feng Huang is a professor of China Agricultural University since January 2018. She was born on August 29, 1976. She got PhD from Institute of Physics, Chinese Academy of Sciences in June 2005, majoring in plasma physics. She has worked in China Agricultural University since July 2005. She was a visiting scholar at Lawrence Berkeley National Laboratory in the United States from September 2011 to July 2012. From December 2021 to December 2022, she is a visiting scholar of GREMI/CNRS, University of Orleans, guest research fellow of Le stadium Loire Valley Institute for Advanced Studies, Centre-Val de Loire region, France. Her group research interests include plasma related researches such as experiment and simulation studies of complex plasmas, plasma application in agriculture, thin film materials, and the combination of plasma and AI approaches (plasma spectrum diagnosis, complex plasma image recognition, AI in plasma agriculture, intelligent control of equipment, etc).

Short introduction on Plasma Agriculture and Science including AI approaches

The use of fertilizers, pesticides and hormones has indeed boosted plant growth, greatly contributing to the increase of agriculture products, but it has also caused a series of problems, such as environmental degradation, soil hardening and fertility decline, and increasingly food safety problems. Thus, exploring the applicable green agricultural technology is crucial for environmental protection and human health. Non-thermal plasma, as a green alternative to conventional chemicals, was proved to be a rapid, effective and environmentally friendly green technique with the potential of boosting agriculture efficiency by alleviating soil toxicity and improving soil vitality, improving plant seed germination and growth, promoting pesticide degradation, etc.
With the rapid development of artificial intelligence, its combination with plasma agricultural can effectively promote the large-scale application of plasma in agriculture, such as, artificial intelligence can quickly identify plasma discharge parameters, control plasma discharge equipment, detect the pesticide residues degraded by plasma, detect the vitality of plasma treated seeds, recognize and classify plasma crops, make the estimation on plasma crop yield, etc.

Dr Éric Robert

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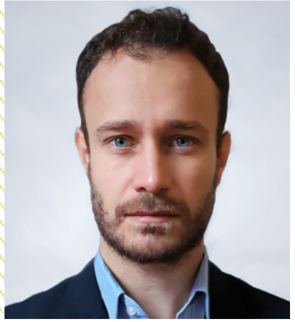
Eric Robert is CNRS senior Scientist at GREMI laboratory, Orléans, France.
He has been involved in the development, diagnostics and applications of gas discharge plasmas for light source, micro electronics, X-rays diagnostics, and from fifteen years in the biomedical technologies.
His recent publications concern the physics of plasma jets, the antitumor action of atmospheric pressure cold plasma jets, the combination of plasma treatment with electrochimiotherapy, the use of plasmas for skin treatment in anti aging strategies.
He is deputy director of GREMI laboratory, in charge of the "plasma for biomedical applications" team, and director of the French network "HAPPYBIO" merging fourty teams connected with the researches on the use of plasmas, pulsed electric field and dynamic phototherapy for biology.
He is board member of the International Society for Plasma Medicine and of the International Plasma Chemistry Society.



Dr Augusto Stancampiano

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Dr Stancampiano is researcher of the CNRS at the GREMI laboratory of Orleans. He received his PhD in Mechanics and Advanced Engineering Science in 2016 at University of Bologna. His research interests include the design and optimization of plasma reactors for biomedical and agricultural applications. He devoted the last years to investigate the potential of cold plasma jets for anti-cancer therapies and cosmetic applications. More recently, his research focuses on the interaction between plasma jets and liquid aerosol. In 2019 he was honoured with the Young Investigator Award of the International Plasma Chemistry Society for his work on a new method to electrically mimic the human body during plasma in vitro experiments.

SPEAKERS

Dr Markus Becker

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Dr. Markus Becker is researcher and head of the department Plasma Modelling and Data Science at Leibniz Institute for Plasma Science and Technology (INP) in Greifswald, Germany. One of his current focuses is the development of approaches and technological solutions to implement the FAIR data principles in the field of plasma science. Based on this, he conducts research on the application of AI techniques and Data Science methods in simulation and data-driven research.

INPTDAT, a FAIR data platform for applied plasma science

Research in low-temperature plasma science is often characterized by small-scale table-top experiments involving diverse methods and devices. As a result, data is extremely heterogeneous and infrastructures are needed to manage and link individual data sets in the sense of making them available for data-driven research. The data platform INPTDAT and the plasma metadata schema Plasma-MDS have recently been developed to address this challenge. The concept underlying these developments is that data obtained in the course of research in a specific subject area by means of a specific experiment and involving specific devices are assigned by the data producers to the respective topic, to a concrete application if applicable, as well as to the related experiment, devices and substrates. In this way, a graph of linked data and further information, e.g. from patents and device descriptions is created, and research data available for specific applications, devices, and/or substrates can be found and re-used immediately. This is particularly beneficial if similar experiments or devices are used in different subject areas and for various applications. The present contribution intents to introduce the FAIR data platform INPTDAT with its underlying metadata schema and it will be discussed how the concept supports cross-domain re-use of research data by making the data directly accessible for data-driven research and development.

Dr Bhaskar Chaudhury

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Bhaskar Chaudhury is currently a professor of Computational and Data Sciences at DA-IICT, India. He received his Ph.D. in Computational Physics at Institute for Plasma Research, India. Prior to joining the faculty at DA-IICT, he worked as a researcher for around six years at LAPLACE Laboratory, CNRS, France. He has been involved in active research in the areas of Computational Science, Data Science, Computational Physics, Machine Learning and High Performance Computing. He has been the Principal Investigator for several national and international sponsored research projects. He has authored more than 100 research papers in reputed peer reviewed journals/ conference proceedings/ book chapters in the area of computational plasma physics, HPC, Data Science and AI/M

EDeep Learning for Extracting Electron Scattering Cross Sections from Swarm Data

Electron-neutral scattering cross sections are fundamental quantities in simulations of low temperature plasmas because several macro-scale quantities ('swarm' parameters) can be calculated from these microscopic cross sections. However, accurate measurements and calculations of cross sections are challenging. Therefore, researchers have attempted to solve the inverse swarm problem of obtaining cross sections from swarm data; but the solutions are not necessarily unique. We have examined the use of machine learning (ML) models for addressing this inverse swarm problem. ML models are trained using the previous determinations of electron scattering cross sections for different gases (available at LXCat website) and their corresponding swarm parameters calculated via the numerical solution of the Boltzmann equation for electrons in weakly ionized gases. Artificial neural network (ANN), convolutional neural network (CNN) and densely connected convolutional network (DenseNet) have been used for this investigation. We compare the performance of different models, towards the prediction of cross sections from swarm data, for a broad range of gas species. Further, we apply Monte Carlo dropout as Bayesian approximation to estimate the probability distribution of the cross sections to determine all plausible solutions of this inverse problem.

Dr Wenzhuo Chen

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Wenzhuo Chen was born in Henan, China. She received her M.S. degree in communication engineering from the University of York, Yorkshire, UK, in 2011. She is now an associate professor in the Department of Electronics and Information, North China Institute of Science and Technology, Hebei, China. And she is currently pursuing for her Ph.D. degree in China Agricultural University. Her current research focuses on the application of plasma in agriculture, computer vision and permanent magnet synchronous motor control.

Shortcut Improved Convolutional Network Application in Plasma-treated Rice Growth Classification

As an agricultural innovation, low-temperature plasma technology is an environmentally friendly green technology that increases rice quality and productivity. However, there is a lack of research on the identification and classification of plasma-treated rice growth. Traditional convolutional neural networks (CNN) can be only suitable for entry-level categorization. Indeed, shortcuts from the bottom layers to fully connected layers can be established feasibly in order to utilize spatial and local information from the bottom layers, which contain small distinctions necessary for fine-grain identification. In this work, 5000 original photographs which include the basic growth information of rice at the tillering stage (containing normal rice and plasma treated rice) were collected. An efficient multiscale shortcut CNN (MSCNN) model with improving the utilization of key information and cross-layer features was proposed. The results show that MSCNN outperforms the mainstream models. The ablation experiment, comparing the average precision of MSCNN with and without shortcuts, revealed that the MSCNN with three shortcuts achieved better performance.

Sarah Chouchene

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Sarah CHOUCHENE received the engineering degree in intelligent and autonomous systems from Polytech Nancy, FRANCE, and the M.Sc. degree in complex systems engineering from university of Lorraine, FRANCE, in 2020. Since November 2020, Mrs S. CHOUCHENE is doing a PhD on the applications of artificial intelligence to plasma physics and machine vision, at Institut Jean Lamour, University of Lorraine, FRANCE, under the supervision of Dr. F. Brochard (Institut Jean Lamour) and Dr. M. Desécures (APREX Solutions)

Detection of Plasma Turbulence in Plasma Fusion Devices Using Ultra-Fast Camera and Artificial Intelligence

It is still a challenge to produce and confine reactor-relevant amount of energy in magnetic fusion devices. One of the reasons is the loss of confinement due to the plasma edge turbulent transport [1]. The work presented in this contribution aims at improving the characterization of the coherent structures known as filaments or blobs responsible of this transport. In the recent years, we have developed a tomographic inversion method to reconstruct tokamak edge turbulence from single fast visible camera [2]. Our method has been improved and applied to passive fast imaging data recorded up to 1 million frames per second in the COMPASS tokamak. Individual plasma filaments characteristics (geometry, velocity...) are calculated automatically using conventional methods, and then compared to Artificial Intelligence (AI) object detection methods. For that purpose, an automatic data labelling method has been developed, making it possible to apply supervised learning rapidly to tens of thousands of plasma turbulence images. Several versions of YOLO algorithms [3] are used and compared to detect and localize filaments, with a best accuracy of 98% obtained with YOLO V7. In this contribution, we present our methodology and latest results of filaments detection and prospects for a better characterization of plasma turbulence with AI.

[1] S. I. Krasheninnikov, Phys. Lett. A 283, 368 (2001)

[2] J. Cavalier et al., Nucl. Fusion 59, 056025 (2019)

[3] J. Redmon et al., arXiv. 1804. 02767 (2018)

Prof. Marcílio de Souto

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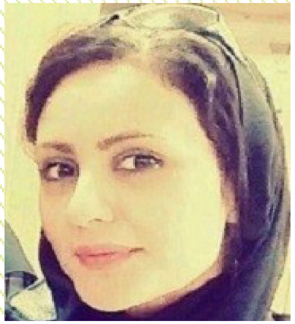
I received a B.Sc. degree in Computer Science from the Fed. Univ. of Rio Grande do Norte (UFRN), Brazil, in 1991, the M.Sc. degree in Computer Science from the Fed. Univ. of Pernambuco (UFPE), Brazil, in 1995, and the Ph.D. degree in Artificial Intelligence from the Imperial College (London), UK, in 1999. I worked as a visiting professor at the Center of Informatics (CIn) of the UFPE for three years. In 2004, I joined, as an associate professor, the Dept. of Informatics and Applied Mathematics (DIMAp) of the UFRN. Currently, I am a full professor at the Laboratoire d'Informatique Fondamentale d'Orléans (LIFO) at the University of Orléans (France). Research topics: Machine Learning, Supervised Learning, Clustering, Hybrid Intelligent Systems, Bioinformatics.

Introduction to Artificial Intelligence with Machine Learning Techniques

The main aim of this talk is to provide to a general audience an accessible and friendly introduction to Artificial Intelligence (AI), with a focus on Machine Learning (ML) techniques. We will start with a definition of AI and how this research domain articulates with that of ML. Then, we will introduce fundamental concepts motivating ML and presenting the differences between types of Machine Learners. More specifically, this talk addresses approaches covering supervised and unsupervised learning, including clustering and neural networks. It considers the application of ML to long-standing problems like medical diagnosis (classification), credit risk modeling (classification/regression), profiling customers (categorization), among others.



Sara Emadi

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I received a B.Sc. degree in Atomic and Molecular physics from the Bahonar University of Kerman in 2008, Iran, and an M.Sc. degree in Astrophysics from Shiraz University in 2011, I am currently researching at the Plasma Research Institute of Kharazmi University as a Ph.D. student.

Structure-independent Prediction of the BM-MSC response to CAP treatment using machine learning algorithms based on plasma emission Spectrometry

The purpose of the present lecture is based on predicting the Helium plasma jet efficiency on the scratch test through the effect on bone marrow mesenchymal cells (BM-MSC) by relating the BM-MSC's response to the optical characteristics of the jet. We expect that the output of the research results in an independent-jet structure prediction of plasma Helium jet efficiency on wound healing treatments only by having the optical emission spectrum of a plasma jet (only by having the voltage and frequency of specified plasma jet under study).

using voltages and frequencies as input data and spectrum images as labels (first data bank), a supervised learning algorithm will be trained. The algorithm will be able to predict the shape of the spectrum and the intensity of the species by receiving the desired voltage and frequency of the specified plasma jet under study.

the second databank will be created including images of the plasma spectrum and the corresponding correlations of each spectrum on the migration and proliferation of the cells. A trained machine learning algorithm will be able to predict the effect of plasma on cells receiving spectrum as inputs. In this way, researchers not only will be able to estimate the amount of growth, death, and migration of mesenchymal cells in the bone marrow but also will be able to find the optimized parameters of their plasma jets for use in wound healing process based on the BM-MSC's stem cells analysis.

Dr Utku Kürşat Ercan

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Dr. Ercan received his BSc degree from Ege University, Department of Bioengineering in 2006 and PhD degree from Drexel University, School of Biomedical Engineering, Science and Health Systems in 2013. In 2014, Dr. Ercan joined to İzmir Katip Çelebi University, Department of Biomedical Engineering. Since then, Dr. Ercan has been acting as the PI of the Plasma Medicine Laboratory in İzmir Katip Çelebi University. Currently, Dr. Ercan is an MC member of the CA20114 – PlasTHER COST action and co-leader of the WG3-Tissue Regeneration in the same COST action.

How Can Artificial Intelligence Contribute to Plasma Medicine Towards Clinical Use?

Plasma Medicine is an emerging field with an increasing number of novel applications in which many of them carry significant potential to be conveyed to the scene of clinical applications. Numerous researchers from different backgrounds put effort to the field of plasma medicine to find novel applications and to enlighten the mechanisms leading biological output of the plasma treatment from all around the globe. However, different research groups use different plasma sources along with different electrodes which makes it harder to directly compare treatment parameters and biological outcomes. Thus, in the field of plasma medicine, researchers face with remarkably large amount of data to be compared and correlated.

In the last decade, artificial intelligence (AI) gained importance in medicine, where it is mainly used in clinical decision support systems and image processing applications to assist healthcare providers towards the accurate diagnosis and treatment.

As plasma medicine gaining importance towards the clinical applications, a better understanding is needed to determine the required plasma treatment

parameters for a desired biological output for a particular application. Thus, due to the capability of AI to analyse large amount of data, it has a great potential to assist not only plasma scientists but also clinicians to refine the plasma treatment to become a part of clinical practice. Furthermore, AI may also contribute to the definition of plasma dose.

Prof. Jalal Fadili

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A Jalal FADILI is a full Professor at ENSICAEN, Caen France and scientific officer at INS2I CNRS in chare of coordinating the AISSAI center. He is a fellow of Institut Universitaire de France . His area of research is at the interface of applied mathematics and data science (optimization, data processing, statistical learning).

The AISSAI center.

As part of its strategic plan on Artificial Intelligence (AI), the French National Center for Scientific Research (CNRS) has launched its AI for Science and Science for AI (AISSAI) Center. The main objective of this center is to structure and organize transverse actions including all CNRS institutes that interact with AI. The aim of this talk is to present the AISSAI center.

Dr Tommaso Gallingani

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Tommaso Gallingani received the master degree in Energy and Nuclear Engineering from the University of Bologna in 2016. He attended a PhD program in the field of industrial applications of non equilibrium plasmas, defending his thesis on investigation and optimization of novel plasma process for biomaterial treatment with professor Vittorio Colombo. During his PhD he was a visiting student at the Case Western Reserve University under the supervision of prof. Mohan Sankaran.
From 2020 he works as a data scientist in Ammagamma, an Italian consulting company in the field of machine learning and artificial intelligence. His main activities are focus on the development and deploy of machine learning algorithms for R&D and industrial applications.

Optimal experimental design for plasma processes investigation and tuning: a multi objective and multi fidelity approach

Experimental data shape our knowledge of the world and are crucial for the development and tuning of physical model. In this context, depending on the problem we are dealing with, laboratory experiments may be expensive (e.g., in terms of time or financial resources) or not fully accessible. Without prior knowledge, the choice of experiments can be achieved applying traditional experimental design. On the other hand, taking advantage of prior correlation found between experimental data, optimal experimental design can guide the experiment masterplan. This is especially true in emerging research fields, where the limited amount of scientific research data is also affected by experimental uncertainty. Plasma based processes belong to this frontier fields and will gain relevant advantages from the use data driven design approaches, eventually enhanced by physical constrains.

The aim of this is work is to present a multi-fidelity and multi-objective experimental design framework whose applications may range from plasma medicine to plasma assisted material processing. The talk will briefly discuss the basics of the mathematical framework and then highlight possible features and approaches that may be applied to the design, validation and optimization of plasma assisted processes.

Prof. Satoshi Hamagushi

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Satoshi Hamaguchi, Ph.D., has been Professor at the Center for Atomic and Molecular Technologies, Graduate School of Engineering, Osaka University since 2004. He specializes in plasma physics and plasma processing technologies. Prior to joining Osaka University, he was Associate Professor of Kyoto University from 1998 to 2004, Research Staff Member of IBM T. J. Watson Research Center from 1990 to 1998, and Research Fellow of the University of Texas, Austin, from 1988 to 1990. He holds Ph.D. degrees in physics from the University of Tokyo and in mathematics from New York University. He is a Fellow of American Vacuum Society, American Physical Society, and Japan Society of Applied Physics.

Introduction to data science applied to plasma science and technologies

The solution to practical problems in plasma science and technologies, just as those in other scientific/technical disciplines, often boils down to establishing a correlation between two sets of data, i.e., "input variables" and "output variables" For example, in the development of plasma-enhanced chemical vapor deposition (PE-CVD) processes to deposit thin films with specific material properties, the essential mission is to select appropriate precursor gas species and process conditions for a given plasma processing tool (input data) to deposit films with desired properties (output data). A good scientific understanding of, e.g., how chemically reactive plasmas behave under given process conditions and how plasma-generated species (ions, radicals, etc.) interact with material surfaces can make such process development far more efficient. However, because chemically reactive plasmas are so complex, gaining a good understanding of the process may not be straightforward. Under such circumstances, data-science techniques such as machine learning (ML) can help our thought process, using modern information science and computational power. The challenges are, however, that a straightforward regression between those two sets of variables often fails because we typically do not have sufficient data and, therefore, we must find other means to uncover their corelations. One way to overcome these challenges is to incorporate our knowledge of underlying physics and chemistry (i.e., "domain knowledge") to augment data in the ML analysis. In this presentation, with some specific examples, we shall discuss how such data-science techniques can be applied to challenging problems in plasma science and technologies.

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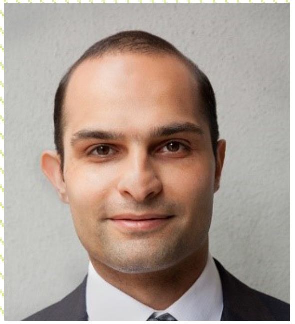
Baoxia Li received the B.S. degree from Henan Normal University, China, in 2017. She received the M.S. degree from Henan Normal University, China, in 2020. She is currently pursuing the phD degree in China Agricultural University. Her research interests include image recognition, data procession and deep learning.

Deep Learning Application in Complex Plasma Image Recognition

Complex plasma consists of charged solid particles, electrons, ions, neutral atoms or molecules, etc. Due to the addition of dust particles and the interaction between particles and the interaction between particles and plasma, a dusty plasma system exhibits many new and more complex properties different from the normal plasma system. This makes the diagnosis and identification of complex plasma different from that of ordinary plasma. That is, in addition to the ordinary plasma diagnosis methods, it is also necessary to consider the parameters related to suspended solid particles. However, the traditional plasma diagnosis method is complicated and the diagnosis process is time-consuming. In response to these problems, combined with the development of deep learning in recent years, we propose a model based on deep learning for complex plasma image recognition. This method can obviously improve the recognition efficient and reduce the time consumed by traditional diagnosis methods, which shows that this method is effective in complex plasma image recognition.



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Ali Mesbah is Associate Professor of Chemical and Biomolecular Engineering at the University of California at Berkeley. Before joining UC Berkeley, Dr. Mesbah was a senior postdoctoral associate at MIT. He holds a Ph.D. degree in Systems and Control from Delft University of Technology. Dr. Mesbah is a senior member of the IEEE and AIChE. He serves on the editorial board of several journal, including IEEE Transactions on Radiation and Plasma Medical Sciences. Dr. Mesbah is recipient of the Best Application Paper Award of the IFAC World Congress in 2020, the AIChE's 35 Under 35 Award in 2017, the IEEE Control Systems Outstanding Paper Award in 2017, and the AIChE CAST W. David Smith, Jr. Publication Award in 2015. His research interests lie at the intersection of optimal control, machine learning, and applied mathematics, with applications to learning-based analysis, diagnosis, and predictive control of materials processing and manufacturing systems.

A Tutorial on Bayesian Optimization for Design of Experiments for Low-Temperature Plasmas

Active learning (AL) is the branch of machine learning concerned with systematically querying samples from an experimental system (or a computational model) to train a data-driven model that maps (experimental) design parameters to process performance measures. AL has emerged as a useful tool for guiding high-throughput experiments and expensive computations in a variety of science and engineering fields. In this talk, we will discuss the promise of constrained and multi-objective Bayesian optimization methods for AL-guided exploration of the multivariable and highly nonlinear parameter space of low-temperature plasmas (LTPs) in a systematic and resource-efficient manner. We will demonstrate how AL approaches can pave the way for automated and "optimal" exploration of the parameter space of LTPs, towards establishing insights into the complex behaviour of the plasma when interacting with interfaces.

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Gizem Dilara Özdemir is a bioengineer, researcher, and plasma medicine enthusiast. She received her B.Sc. degree in Bioengineering, from Ege University and her M.Sc. degree in Biomedical Technologies from Izmir Katip Celebi University, Turkey in 2017 and 2020, respectively. Currently, she is a Ph.D. candidate in Biomedical Technologies and Research Assistant in Department of Biomedical Engineering at Izmir Katip Celebi University, Turkey. She is also an upcoming visiting researcher at Harvard Medical School. Her primary research interest includes plasma medicine, microbiology, cell culture research and combination of these research areas with today's popular research topic, artificial intelligence.

Prediction of Oxidative Strength of Cold Atmospheric Plasma Activated Water via Paper-Based Sensor: A Machine Learning Approach

Plasma parameters that are needed to activate a liquid for desired therapeutic effect cannot be compared due to the diversity in between the plasma sources and electrode geometries from different research groups. Therefore, a standard method has not been achieved. Plasma-generated species are mostly oxidizing agents and the determination of oxidative strength of plasma-activated liquids (PALs) by different methods and correlation of results from those different methods may assist to fill the gap in between required plasma parameters and desired therapeutic effect of PALs. This study aims to estimate the oxidative strength of plasma-activated water (PAW) with respect to plasma treatment time using paper-based colorimetric sensors and machine learning (ML) methods. Colorimetric detection caused by reactive species was performed using starch+potassium iodide (KI) and tetramethylbenzidine (TMB)+KI. The color change caused by PAW was evaluated with different ML algorithms. Fine Tree Classifier (FTC) yielded 85.9% and 93.7% accuracy for the starch+KI and TMB+KI solutions, respectively. Our results demonstrated the capability of ML algorithms for the prediction of the oxidative strength of PALs. Considering the wide usage of ML, this pilot study may provide a basis to understand the underlying biological outcomes of PALs.

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Mehmet Akif Özdemir is a biomedical engineer, researcher, and artificial intelligence enthusiast. He received his BSc degrees in Biomedical Engineering and Computer Engineering (Double Major), and his MSc degree in Electronics and Communication Engineering from Kocaeli University, Turkey in 2016, 2017, and 2019, respectively. Currently, he is a Ph.D. candidate in Biomedical Technologies and a Research Assistant in the Department of Biomedical Engineering at Izmir Katip Celebi University, Turkey. He is also an upcoming visiting researcher at Harvard Medical School. Besides, he is a Senior Associate Editor at BMC Medical Informatics and Decision Making and services as an editorial board member in three other WoS-indexed qualified journals. His primary research interest includes biomedical signal and image processing, deep learning and machine learning algorithms, and neuroscience.

Can Machine Learning Predict the Antimicrobial Activity of Cold Atmospheric Plasma-Activated Liquids?

The antimicrobial effects of plasma-activated liquids (PALs) depend on many different variables, which complicates the comparison of various studies and determining the most dominant parameters for the antimicrobial effect. Machine learning (ML) algorithms on PALs could present a new perspective to better understand the influences of various parameters on their antimicrobial effects. In this study, comparative supervised regression ML models are presented by using previously obtained data to predict the in vitro antimicrobial activity of PALs quantitatively. The best test score of R2 of 0.75 by the Random Forest Regressor (RFR) is obtained. Accurate prediction of the antimicrobial activity of PALs can be possible by an ML framework without conducting any in vitro experimental studies. Furthermore, ML could contribute to a better understanding of plasma parameters that have a dominant role in the desired antimicrobial effect.

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Sylwia Ptasinska holds a joint appointment in the Department of Physics and Astronomy and Radiation Laboratory of the University of Notre Dame, USA, as a professor of physics. She earned her M.Sc. at the University of Maria Curie-Sklodowska in Lublin, Poland, in 2002, and her Dr. rer. nat. and habilitation at the Institute of Ion Physics and Applied Physics at the University of Innsbruck, Austria, in 2004 and 2011, respectively. Her research involves a wide range of experimental studies on low-energy electron interactions with molecules, surface and interfacial processes, and plasma physics and applications.

Revealing low-temperature plasma efficacy through a dose-rate assessment machine learning framework

Recent advances in plasma technology have developed a non-traditional type of radiation formed due to electric discharges under ambient conditions, called low-temperature plasmas (LTPs), and unlocked a wide breadth of potential applications in the medical areas. Yet, its clinical application cannot be realized without rigorous protocols for assessing radiation dose rate. We provide an alternative approach to the standard dosimetry techniques, which often fail. Here, we reveal the plasma dose rate based on the correlation between the experimental outcomes observed in DNA exposed to LTP and other types of radiation that we incorporated into predictive modeling of plasma-induced DNA damage.

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My name is Luigui Salazar and I am currently doing my PhD degree at Institute for Magnetic Fusion Research (IRFM), CEA-Cadarache and at the Jean Lamour Institute, Nancy. As a future PhD, I would like to contribute to science development by working on different projects around the world and exchanging experience, thereby keep improving my skills in different areas of my professional life.

Since the apprenticeship program that I followed during my master degree, I have been working in different areas such as Robotics, Mechanics, Electro-mechanics, Control engineering and Signal Processing/AI. The latter is the approach that I take into account for the analysis of turbulence properties in High temperature Plasmas.

Since the beginning of my PhD work, I had the opportunity to take participation to different workshops/Summer Schools such as in reflectometry (IRW15) and parallel computing/AI at the MIT.

Spectral modes extraction using Signal Processing and Artificial Intelligence techniques based on reflectometry data

The identification of turbulence sources would drive to a deeper understanding of confinement dynamics in tokamak plasmas. Turbulence results from a mixture of instabilities corresponding to sources at different time and spatial scales. Furthermore, the reflectometry diagnostic based on radar principle can be used to measure the turbulence characteristics. As it was shown in the T-10 and TEXTOR tokamaks, the reflectometry spectrum can be decomposed into several

components: Broadband component, Quasi-coherent modes and low frequency components.

Under this idea, the aim of this work is to perform an extraction of spectral components and then classify them and study their characteristics in different plasmas scenarios in order to find a connection with turbulence instabilities such as the ITG, ETG, and TEM and other components such as MHD modes and Zonal flows. This procedure starts by a semi-supervised technique in order to get rid of pathological signals i.e. signals with a very low Signal to noise ratio, high Doppler Effect, etc. After that, our extraction algorithm is applied and the spectral components are described by their plasma conditions and spectral descriptors.

Our extraction algorithm has been validated in TEXTOR and ToreSupra data: physical and statistical properties of signals are preserved after extraction.

A big data approach is currently considerate to study Quasi-coherent modes behaviour in different plasma scenarios.

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Xiaojiang Tang is studying for PhD in the China Agricultural University. Her research interests include smart agriculture, artificial intelligence and the application of plasma in agriculture. The purpose is to use plasma technology to process rice seeds, and use artificial intelligence technology (including deep learning, machine learning, 3D reconstruction, image recognition, classification and prediction, etc.) to study the impact of plasma technology on rice phenotypic characteristics and the impact on rice quality.

An MLP Network Based on Residual Learning for Plasma Rice Recognition

In order to recognize several kinds of rice (including the rice grown by plasma seed treatment), the datasets of the hyperspectral images (HSIs) of rice were constructed. Multilayer perceptron (MLP) has a good recognition performance on rice HSIs because it removes translation invariance and local connectivity. Residual learning can improve the feature extraction ability of MLP network because of retaining the original information, preventing the model from degenerating, and facilitating the rapid convergence of the model. Therefore, a rice hyperspectral image recognition model based on MLP network and residual learning is proposed. The results show that the proposed model has a higher recognition accuracy than the other common recognition models. In addition, the model has been verified on two public datasets.

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Xin Tu is Professor of Plasma Catalysis in the Department of Electrical Engineering and Electronics at the University of Liverpool. His research mainly focuses on plasma chemistry and plasma catalysis for gas clean-up, CO2 conversion, CH4 activation, hydrogen production, nitrogen fixation, biomass and plastics conversion, as well as nuclear decommissioning. He has published over 170 peer-reviewed journal papers (H-index 58, >9000 citations) and 7 book chapters. He has given over 60 invited talks at international conferences and has chaired 5 international conferences. He was the Editor of the book "Plasma Catalysis: Fundamentals and Applications", published by Springer Nature in 2019.

Machine learning for the optimization of plasma chemical processes

Non-thermal plasma (NTP) is a promising and emerging technology for environmental clean-up and the synthesis of fuels and chemicals. However, plasma chemical processes are complex, and the reaction performance of these processes is typically controlled by a number of process parameters [1]. Significant efforts have been devoted to investigating the effect of individual process parameter on a range of plasma chemical reactions, whereas a fundamental understanding of the contribution of each parameter and the interaction of different parameters to plasma chemical reactions is still limited, making it difficult to optimize the process parameters and predict the plasma reaction performance rapidly.

Machine learning (ML) has been considered a promising tool to learn from data to find insights or make fast predictions and optimization of target properties. The advances in ML are making a significant impact in many fields such as material synthesis & design, heterogeneous catalysis and chemical processes. However, the use of machine learning tools for the prediction and optimization of plasma chemical processes is still limited [1].

In this presentation, we will focus on the use of ML tools for the predication and optimization of plasma chemical synthesis processes, including i) plasma-catalytic oxidation of methanol for gas cleaning; ii) plasma reforming of methane and carbon dioxide for the synthesis of fuels; iii) plasma reforming of tars from biomass gasification.

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Gonadotropins in the Physiopathology: Current advances in the Mechanisms of Action
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Dr Duangjai Tungmunnithum, Dr Christophe Hano & Prof. Leslie Boudesocque-Delaye
NaDES for biomass valorization: new insight of a green technology
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Dr Kathia Zaleta & Prof. Patrick Vourc'h
RNA therapeutics and Neuroscience
24-25 May 2022

Dr Cynthia Gabbay, Dr Brigitte Natanson & Dr Valentina Litvan
Jewishness between Latin America and Europe: Languages in Contact, Linguistic Imaginaries and Translation
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Dr Duangjai Tungmunnithum & Dr Christophe Hano
1st Franco-Thai Seminar on Phytocosmeceutical Research and Applications
11 May 2022

Dr Franciska Vidáné Erdő, Dr Franck Bonnier & Prof. Emilie Munnier
Skin Models in Cosmetic Science: Bridging Established Methods and Novel Technologies
7-8 April 2022

2021

Dr Robert Courtois
De la séduction à l'agression ? La question du harcèlement
29-30 November 2021

Prof. Adrian Wolstenholme, Prof. Georg von Samson-Himmelstjerna & Dr Cédric Neveu
New approaches to get around roundworms
29 November - 1 December 2021

Dr Valérie Hayaert, Hélène Jagot & Christophe Regnard
Justice en scène(s)
11-12 October 2021

Dr Raphaël Cahen, Prof. Pierre Allorant & Prof. Walter Badier
Law(s) and International relations : actors, institutions and comparative legislations
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Prof. Eugeen Schreurs, Prof. Philippe Vendrix & Wendy Wauters
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2-4 September 2021

Dr Cristina Del Rincon Castro & Dr Elisabeth Herniou
2021 International Congress on Invertebrate Pathology and Microbial Control & 53rd Annual Meeting of the Society for Invertebrate Pathology
28 June - 2 July 2021

Dr Edurne Serrano-Larrea, Dr Conchi Ania & Dr Encarnacion Raymundo-Piñero
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Réhault-Godbert
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2020

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Exploring the molecular diversity of grape, a source of natural ingredients
3 December 2020

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Capitalism, War and Biopolitics in the Pandemic Era
18 - 19 November 2020

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11 Mai 2020

Dr Thimmalapura Marulappa Vishwanatha & Dr Vincent Aucagne
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Dr Arunabh Ghosh & Prof. Fouad Ghamous
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International Meeting on Plasma Cosmetic Science
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Lost in Renaissance
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