JOŽEFSTEFAN
INTERNATIONAL POSTGRADUATE SCHOOL

Summary of Self-Evaluation Report for 2022/23 Academic Year

Mission · Integration into Environment and Society · Study Programmes · Higher Education
Teachers · Students · IPS Awards · Student Achievements · Social Life · Study and Research Support

DEAN'S FOREWORD

Prof. Dr. Milena Horvat, Dean

At a time when we are facing many challenges and crises, the role of education and training for society is more crucial than ever. As a starting point for the self-evaluation of our school, it is important to understand that our mission is to provide a world-class academic environment that enables the continuous growth of knowledge. This knowledge not only enriches all levels of society but also gives hope for the future.

At the heart of our mission is the creation and transfer of knowledge through intensive research, innovation and postgraduate education. At IPS, we pay special attention to student empowerment. We believe that empowered students are the key to sustainable progress in society. Therefore, we encourage students to actively participate in research projects, provide them with access to supervisors from practice and encourage them to think and work independently.

We are also aware of the challenges ahead, and we are keen to establish an intensive cooperation with our Alumni Club. Together with the graduates, we would like to contribute to better overcoming intergenerational challenges, as we are aware that the experience and knowledge of our graduates can make an important contribution to the development of the school and society. The Alumni Club would thus be an invaluable source of mentoring, networking and exchange of ideas and experiences between students and alumni, which would further strengthen the empowerment process of our students and contribute to the overall development of the school.

Quality assurance is fundamental to the existence of IPS, and we are constantly striving to improve innovation, pedagogical processes and support services. High scores in student surveys reflect student satisfaction, which encourages us to continue our work and development. Through the process of self-evaluation, we are aware that our school is part of a larger system that contributes to strengthening the role of excellent science and high technologies in the development potential of society. We therefore strive to remain a leading institution in research, education and innovation, believing that the continuous growth of knowledge is the key to a better future for all.

Mission of IPS

The mission of the Jožef Stefan International Postgraduate School (hereinafter IPS) is to **ensure the highest quality of master and doctoral postgraduate studies** with the help of a research and educational process in an intensive R&D and innovative environment.

Additionally, the school aims to contribute to **strengthening the role of excellent science and high technologies** in the development potential of the society, which can significantly contribute to the **economic power and harmonious social development**. The IPS acts as a **centre of excellence** closely interlacing basic research with postgraduate education and innovation development. Research achievements are directly incorporated into innovation projects aimed at developing production, service activities, and management. IPS masters and doctors, together with their supervisors and co-supervisors, contribute to new achievements in basic research and innovation development.
Slovenian Quality Assurance Agency for Higher Education (**NAKVIS**) established that in addition to the legal provisions, the IPS also meets the Criteria for Accreditation and Reaching Quality Standards, as defined in the Criteria, and therefore prolonged the accreditation of the school until 30 September 2024.

COLLABORATION WITH NATIONAL INSTITUTES

The basic strategy of the IPS is to **invite leading researchers** from the founding and partner institutes in the selected fields and include them in the research and educational process of the school. Thus, in collaboration with the IPS founders and partners, who also provide state-of-the-art research infrastructure, the school ensures material and intellectual capacities in order to educate new masters and doctors of science.

Jožef Stefan Institute (JSI)
Institute of Metals and Technology (IMT)
National Institute of Biology (NIB)

INDUSTRIAL PARTNERS

17 founders and associate partners:
BSH, Nazarje
Cosylab, Ljubljana
Domel, Železniki
ETI, Izlake
Gorenje, Velenje
HYB, Šentjernej
Kolektor Group, Idrija
LTH Castings, Škofja Loka
Port of Koper, Koper
Premogovnik Velenje, Velenje
Salonit, Anhovo
Slovenian Insurance Association, Ljubljana
Štore Steel, Štore
Telekom Slovenije, Ljubljana
Termoelektrarna, Šoštanj
Trimo, Trebnje
Unior, Zreče

The IPS was established mostly out of the need for an efficient transfer of excellent research achievements to the industry and the service sector.

In collaboration with other institutes and the industry, the IPS sets up joint development projects with excellent foreign and Slovenian professors and students.

IPS acts as a centre of excellence, closely interlacing basic research with education and innovation development.

IPS fosters cooperation with leading national and foreign institutions, as well as with scientists and research groups.

Integration of IPS into Environment

The IPS cultivates this integration by directly connecting and implementing all its activities with founding and partner institutes, by contributing to the world treasury of knowledge, and by increasing the efficiency of drawing from it. Great concern is devoted to inviting excellent Slovenian and foreign institutions to collaborate with the IPS in the field of study programmes, projects and special actions by individually including international leading scientists as IPS visiting professors and by encouraging collaboration between IPS professors and leading research groups in the framework of joint projects.

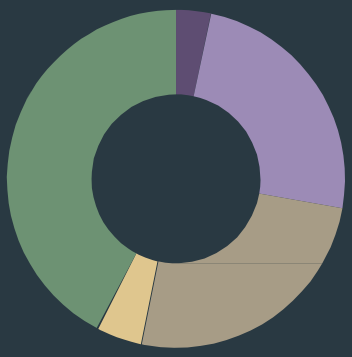
IPS STUDENTS FROM AROUND THE WORLD

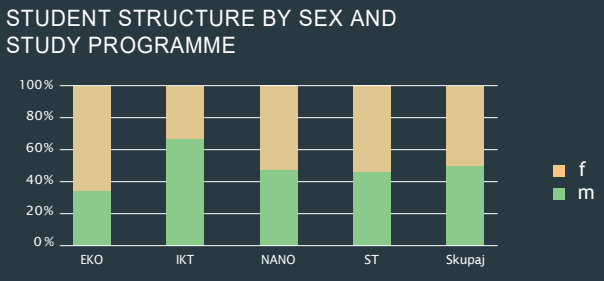
35 % of IPS students come from outside of Slovenia (shown as green on the map), mostly from Europe:

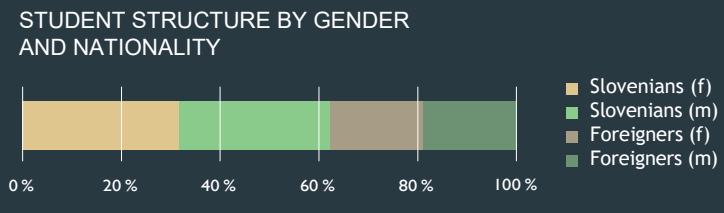
Argentina
Azerbaijan
Benin
Bosnia and Herzegovina
Brazil
Montenegro
France
Greece
Croatia
India
Iran
Ireland
Italy
Kosovo
Lebanon
Morocco
Germany
Netherlands
Pakistan
Romania
Russian Federation
North Macedonia
Syria
Serbia
Tunisia
Turkey
Ukraine
United Kingdom
Vietnam

STUDENTS' ATTITUDE TOWARDS KNOWLEDGE IN SOCIETY AND ENVIRONMENT

IPS students play different roles in communicating the knowledge and experience they gain through their studies and research to the public. They share their views through different communication channels: by participating and presenting at international symposia and conferences, by participating in video presentations by research organisations, in radio and TV interviews, in writing national expert reports and supporting documents, in publishing scientific and professional articles and, finally, through social networks such as Twitter, as part of projects or on their profiles. They gain experience by coordinating foreign visits in research teams and by organising workshops and project meetings. They also act as editors of conference proceedings, and international portals, in the development of publicly accessible mobile and web applications and the preparation of databases. Some of them are already proving themselves as visiting lecturers at foreign universities and working supervisors for master students.

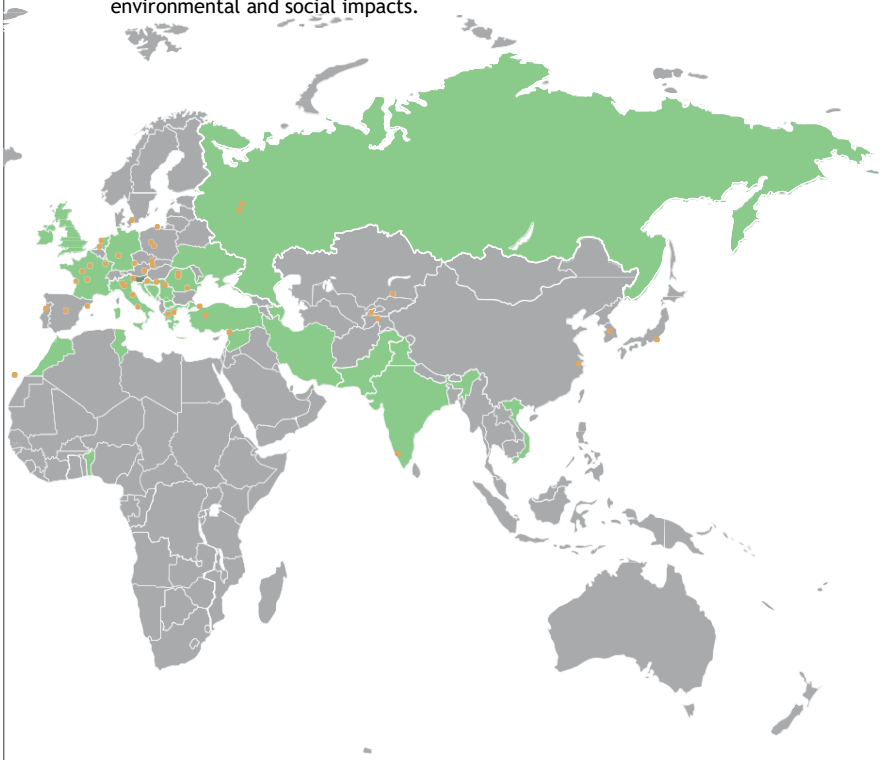






IPS PROJECTS

The IPS has its own research team, which was in 2022/2023 involved in one **ARIS** programme and 2 ARIS projects (formerly ARRS), as well as in European and economic projects. The IPS is participating in the **IPM Decisions** project, under the Horizon 2020 programme, which has created an online platform for farmers and consultants to monitor and manage pests. This research has led to the development of EcoEnvAi, a sustainable decision-making system with artificial intelligence that helps decision-makers in sustainable agriculture to make reliable decisions (https://ecoenvai.ijs.si/). The IPS is also involved as a project partner in three **Erasmus+ projects**, namely the AIDA project on encouraging the young generation to use digitalisation in a sustainable way, the TSAAI project on developing the "FUTUR-IA" platform for training students on applied artificial intelligence, and the DECIDE project on developing multi-criteria guidelines and a tool for deciding on career paths and the competences needed in future innovative professional profiles.
On 1 January 2022, the IPS has started implementing the two-year RESPO X project within the Erasmus+ KA2 "Collaborative Partnerships in Tertiary Education". The project collaborates with three higher education institutions from Spain, Belgium and the Netherlands. The aim of the project is to develop and implement RESPO X, a web-based application that provides students with a systematic solution for making decisions on the optimal training choices to improve their professional and personal competences and skills needed for future jobs. On 1 June 2022, it launched the **Norway Grants** project RESPO-VI, where together with two Slovenian partners and the Norwegian University of Science and Technology (NTNU), it is improving the competences of STEM students by using digital solutions to monitor the development of competences and deliver training. IPS is also participating as a project partner in the **EIT** RIS-DustRec-II project, aiming to increase capacity in the RIS region by actively involving higher education students in the development of a viable recovery technology that generates minimal waste emissions and improves environmental and social impacts.



INTERNATIONAL AREEMENTS

The IPS currently holds **45 collaboration agreements** with foreign and national research and higher education organisations (shown as dots on the map):

Adam Mickiewicz University, Poznań, Poland
Al-Farabi Kazakh National University, Almaty, Kazakhstan
Anadolu University, Eskisehir, Turkey
Aristotle University of Thessaloniki, Greece
Autonomous University of Madrid, Spain
Babes-Bolyai University, Cluj-Napoca, Romania
Bauman University, Moskva, Russia
Deggendorf Institute of Technology, Germany
Joint Institute for Nuclear Research, JINR, Dubna, Russia
Josip Juraj Strossmayer University of Osijek, Croatia
Korea Advanced Institute of Science and Technology KAIST, Daejeon, South Korea
La Rochelle Université, France
Mahatma Gandhi University, Kottayam, Kerala, India
Mining-Metallurgical Institute of Tajikistan, Tajikistan
Montanuniversität Leoben, Austria
Mustafa Kemal University, Antakya, Turkey
National School of Computer Science for Industry and Business, Évry, France
National University of the South, Bahía Blanca, Argentina
Roskilde University, Denmark
Sabanci University, Istanbul-Tuzla, Turkey
Slovak University of Technology in Bratislava, Slovakia
Technical University of Cluj-Napoca, Romania
Technical University of Darmstadt, Germany
Tokushima Bunri University, Tokyo, Japan
Tomas Bata University in Zlín, Czech Republic
University of Amsterdam, the Netherlands
University of Antwerp, Belgium
University of Barcelona, Spain
University of Belgrade, Serbia
University of Bucharest, Romania
University of Gdansk, Poland
University of Ioannina, Greece
University of La Laguna, Spain
University of Limoges, France
University of Lorraine, Nancy, France
University of Pavia, Italy
University of Perugia, Italy
University of Porto, Portugal
University of Salerno, Italy
University of São Paulo, Brazil
University of Tours, France
University of Udine, Italy
University of Wrocław, Poland
University of Zagreb, Croatia
Zhejiang University, Hangzhou, China

Study Programmes

NANOSCIENCES AND NANOTECHNOLOGIES

master and doctoral degree programme

The Nanosciences and Nanotechnologies programme represents a field at the crossroads of physics, chemistry, and biology, combined with elements of electrical engineering, medicine, and environmental sciences. It explores nature and the use of systems with components of nanometric size. Potential applications can also be found in almost all economic sectors.

PROGRAMME PRESENTATION

The principal objective of studying nanosciences is to acquire the understanding of the structure and dynamics of materials at an atomic and molecular level, which is also the basis for their macroscopic properties. Through knowledge of methods of atomic and molecular micromanipulation we can build new molecules, devices and machines with entirely new properties and possibilities of application. Some examples are projects aimed at building atomic-scale computer components, constructing new sensors at a molecular level, which can sense specific viruses and bacteria, magnets at a level of specific molecules, nanoparticles that serve as carriers of active substances for targeted cancer therapies, micromotors and molecules which can use sunlight to control environmental contaminants.

One of the programme's virtues is also successfully ensuring multidisciplinary approaches of nanophysics, nanochemistry, biosciences, material sciences and nanomechanics. This systematic cultivation of coordinated inter- and multi-disciplinary approaches allows for a fast discovery of new fields of applications. This is also supported by the project-oriented structure of the study programme, as all students are directly involved in economic, national, and international projects. Within the framework of projects and alongside research work, they learn and deepen the methods for creating, transferring and applying knowledge. Being involved in the projects gives the students access to the state-of-the-art research equipment within the JSI, associate institutes, and centres of excellence.

PROGRAMME IN THE CONTEXT OF USER NEEDS

The programme is an interdisciplinary postgraduate programme covering the following research areas:

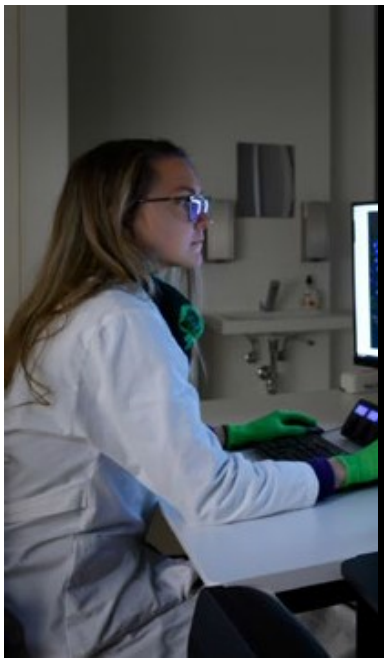
1. **new nanomaterials and nanochemistry,**
2. **nanophysics** (including physics of artificial nanostructures and the development of methods of research and nanomanipulation of atoms and molecules, and their dynamics),
3. **biosciences** (including biomedicine),
4. **advanced metallic materials,**
5. **nanomechanics** (including mechanics of time-dependent materials).

All the fields also include the fundamental knowledge needed for establishing successful communication with experts in the field of commercial and civil law, microeconomics of companies and project management, and the basics of sustainable development.

More information:

MASTER STUDIES

DOCTORAL STUDIES



The Nanosciences and Nanotechnologies programme attracts a lot of students each year. The principal reasons behind that are the prospects of nanotechnologies in relation to the development of high technologies and products with high added value. To the same extent, young researchers are also attracted by breakthrough research in this field, interesting international projects and excellent researchers acting as their supervisors.

The implementation of the study programme is related to national and EU projects, in which the ICT programme achieves impressive results both in terms of volume as well as in the complexity of the research in which the students are directly involved.

INFORMATION AND COMMUNICATION TECHNOLOGIES

master and doctoral degree programme

Information and Communication Technologies is an interdisciplinary postgraduate study programme following the latest tendencies in the field. With excellent research results it also directly contributes to surpassing the existing boundaries of knowledge and technologies in the field. The study programme includes the following fields: knowledge technologies, advanced internet technologies, computer structures and systems, information security systems, intelligent systems and robotics, advanced concepts in telecommunications, while the master programme also covers digitalisation.

PROGRAMME PRESENTATION

The study programme is oriented towards solving actual problems and digital challenges of the modern society. Examples of such challenges are the Future Internet and the Internet of Things as factors that will have a decisive impact on the life of the society in the future years, and lately also the digitalisation of economy, the development of services of the digital market, and artificial intelligence. Despite concerns that these fields interfere with the living space of an individual, they should in fact be accepted as a challenge for further development, an opportunity to realise creative ideas, and support for the analysis of data in interdisciplinary research. The reoccurring economic crises will also shape the future of workplaces in numerous branches of economy. Basic knowledge of information and communication technologies is crucial even for our sole survival, while a more profound knowledge of the field is becoming vital in research work, development of new products and services, economic analyses, medicine, and the entire field of sustainable development.

PROGRAMME IN THE CONTEXT OF USER NEEDS

Modern information and communication technologies are of key importance for the economic and social progress: new and efficient ways of exchanging information expand the development possibilities of production, the service sector, scientific, cultural and social establishments, and in addition fundamentally support the transfer of knowledge with the aim of sustainably developing a knowledge society. In the increasingly globalised economy, the information and communication technologies are crucial for ensuring competitiveness and economic growth of companies, and also entire countries.

Development of the knowledge society primarily depends on the development of the knowledge-based economy which further on depends on the most educated and enterprising experts who master quick access to information, efficient ways of managing it and recognising essential messages, as well as its incorporation into problem solving within the development and optimisation of new procedures, products, and services. Information and communication technologies play an important role in increasing the employment structure in every single field since Europe – and Slovenia within – can face the world competition only with a highly competent workforce that masters digital skills and where the ability of quickly acquiring, managing, transferring and applying information is an inevitable requirement of the modern management. For the needs of integration into the emerging European digital market, attention in delivering the learning content will be devoted to the digitalisation of the economy, which is a prerequisite for an equal position of economic operators in the implementation and operation of the digital market and related trust services.

The Information and Communication Technologies postgraduate study programme therefore provides to future masters and doctors of science fundamental knowledge in the given fields, while at the same time it prepares them for solving key development problems, such as increasing the efficiency of production and marketing processes, management support in companies, administrative authorities and in banking, upgrading business processes with ICT technology, ensuring business security, tackling the challenges of artificial intelligence, developing new branches of economy, environment and health protection, as well as creating new quality employment opportunities in all the given fields.

Within the programme, research is mostly conducted in the following fields:

1. **knowledge technologies,**
2. **advanced internet technologies,**
3. **computer structures and systems,**
4. **intelligent systems and robotics,**
5. **modern concepts in telecommunications,**
6. **information security systems,**
7. **digitalisation.**

The application of acquired knowledge includes management of networks, high performance computer resources and artificial intelligence technologies, and, in particular, machine learning for computer-assisted analysis of databases/data warehouses generated as a result of scientific research in the fields of physics, chemistry, biology, biochemistry and pharmacology, bioinformatics, environmental sciences, and also in the fields of social and economic sciences, as well as the data that is accumulated as a result of ambient measurements and data acquisition on the Internet.

More information:

MASTER STUDIES

DOCTORAL STUDIES

ECOTECHNOLOGIES

master and doctoral degree programme

The Ecotechnologies programme incorporates science that supports the efforts of meeting the needs of the humankind in harmony with nature while causing as little damage to the environment as possible, especially by efficiently incorporating natural processes. As it is oriented towards solving actual problems, which calls for a comprehensive approach, ecotechnologies are characterised by bringing together achievements from natural, technological and social sciences, which are oriented towards sustainable development. That makes the multidisciplinary approach a strong characteristic of the Ecotechnologies programme. Emphasis is also placed on the environmental and economic approach.

PROGRAMME PRESENTATION

The strategy of sustainable development incorporates the integration of environmental, technological, economic and social objectives, especially in production and consumption.
The study programme provides the acquisition of knowledge and the development of skills in order to be able to carry out competent research, establish international connections, and manage sustainability-oriented development, transfer and application of ecotechnologies.

The emphasis is placed on threefold qualifications:

- broadening and deepening of scientific content, methods and techniques in selected fields of natural sciences, technologies, engineering and informatics, which will support the strategic choice,
  development, transfer, optimisation, exploitation and supervision of selected ecotechnologies for improving business efficiency while at the same time satisfying broader social interests in sustainable development,
- developing competences and skills for raising the quality of processes, products and services, and increasing the added value while striving for excellence and maximal implementation of the principles of sustainable development,
- developing an integral way of thinking which surpasses individual fields and develops competences for: communicating with experts from other disciplines and fields, comprehensive problem definition, systemic approaches, decision-making and solving complicated problems in teams, and strategic planning with a long-term perspective.

It should specifically be emphasised that the school systematically steers the Ecotechnologies postgraduate study programme from the previously predominant environment protection content to a more comprehensive orientation towards sustainable development, especially for improving the efficiency of using input materials and energy sources. This requires a significantly stronger emphasis on a more efficient development and transfer of ecotechnologies and introducing sustainability-oriented consumption. Considering these demands, the Ecotechnologies programme requires the development and implementation of multidisciplinary synthesis methods, which the IPS systematically cultivates in the framework of postgraduate research oriented towards sustainable development.

PROGRAMME IN THE CONTEXT OF USER NEEDS

The Ecotechnologies study programme is embedded in development projects intended to achieve ecotechnological reform and progress in the production, service activities, and public services. The programme emphasises economic efficiency alongside environment protection.
Most research is tied to solving actual problems in the following fields:

1. **tools for environmental quality control which also include integrated modelling tools for political decision-making**
2. **development and testing of environmentally acceptable materials,**
3. **development and testing of clean technologies,**
4. **characterisation and treatment of waste and waste waters,**
5. **water management,**
6. **plasma technologies,**
7. **development of intelligent systems for environmental quality control,**
8. **sustainable civil engineering,**
9. **food and environmental health technologies.**

One of the programme's virtues is also that it successfully ensures multidisciplinary approaches which include the following fields: chemistry, geology, biochemistry, biological sciences, biotechnology, hydrology, ecotoxicology, chemical engineering, biostatistics, and modelling. In addition, these disciplines are to a great extent intertwined with tools that ensure support to political decision-making in the field of environment and human health and/or ensure a practical value in the industrial environment. This is also supported by the project organisation of executing the study programme, as all students are directly involved in economic, national, and international projects. Within the framework of projects and alongside research work, they discover and deepen the methods for creating, transferring and applying knowledge. Being directly involved in these projects gives the students access to the state-of-the-art research equipment within the JSI, associate institutes, and centres of excellence.

More information:

MASTER STUDIES

DOCTORAL STUDIES

The implementation of the study programme is intertwined with national and especially EU projects within which the Ecotechnologies programme achieves enviable results – both in the scope and complexity of research which also directly involves the postgraduate students of the school.

SENSOR TECHNOLOGIES

doctoral degree programme

The Sensor Technologies programme is an interdisciplinary doctoral study programme that was first implemented in the 2016/2017 academic year.
Sensors have become an invisible yet indispensable part of our world. For example, our cars are full of sensors for regulating the engine functioning, speed, fuel consumption, temperature, ventilation and, last but not least, our own safety. Environmental sensors are crucial for pollution control. Biosensors, among which nanosensors, promise considerable progress, especially in healthcare. Designing and manufacturing of so many different sensors is enabled by sensor technologies which are based on outstanding achievements in science and technology.
The Sensor Technologies study programme connects knowledge from the fields of physics, chemistry, biology, materials, environmental and technical sciences, nanosciences and nanotechnologies, as well as information and communication technologies.

PROGRAMME PRESENTATION

The objective of the doctoral degree programme is to acquire knowledge of sensors and sensor technologies from the selected fields of physics, chemistry, materials, environmental and technical sciences, nanosciences and nanotechnologies, as well as information and communication technologies. It also encourages the development of an integral way of thinking as a foundation for interdisciplinary research. Beside mastering the methods and techniques of research work, the students will also develop competences for conducting independent and team R&D work and for using the acquired knowledge in practice.

PROGRAMME IN THE CONTEXT OF USER NEEDS

The programme systematically connects knowledge from the field of sensors and sensor technologies with great international expertise in order to educate a highly-skilled workforce to support the penetration of economic development projects to the global market while at the same time ensuring socially balanced sustainable development.

This interdisciplinary study programme provides the acquisition of knowledge and the development of skills in order to be able to carry out competent research, transfer the scientific achievements to industrial development, and establish international connections in the following fields of sensor technologies:

1. sensors for ionizing photons and particles,
2. physical and chemical sensors,
3. biosensors,
4. information and communication technologies in sensorics.

The implementation of the study programme is intertwined with national and international projects, especially within the framework of the European Community, and projects carried out with partners from the industry.

More infromation: DOCTORAL STUDIES

Sensors help us recognise selected conditions in the environment in real time and react to them systematically. Their application possibilities therefore stretch to almost all fields of human activity. With increasing economic and environmental demands, the sensors have become an important integral part of the so-called “smart” devices and thus a promising opportunity for the economy.

IPS Teaching Staff

A great majority of IPS professors are employed full time at IPS founders and partners, especially at the Jožef Stefan Institute which is also the seat of the IPS. Supervisors are therefore available to collaborate with the students directly.

The structure of academic titles for 184 IPS professors is the following: 88 full professors, 46 associate professors, 50 assistant professors. We only have 14 teaching assistants as the research and education process of the postgraduate studies requires a predominantly highly demanding and individualised supervision work. The share of less demanding group forms of study, which normally require the help of teaching assistants, is very small. Considering the study fields and the standard of studies at the IPS, our postgraduate students are in fact already at the level of teaching assistants.

TEACHING STAFF SELECTION CRITERIA

The basic criteria for selecting the teaching staff of the Jožef Stefan International Postgraduate School are their internationally highly acclaimed scientific quality, development-oriented attitude, and talent for supervising students.
Since 2019, a domain has been available on the SICRIS website, which gives access to bibliographic indicators of performance for appointment to title.
Among other criteria is also their creative role in national, European and international projects, to which they also include the IPS students, and their willingness to adapt the study programmes according to the specific needs of a student's research work, i.e. the so-called "tailored studies".

VISITING PROFESSORS

The IPS is especially interested in directly including brilliant scientists from leading research groups around the world in IPS programmes. Such groups usually operate within acclaimed institutions. The IPS systematically maintains personal contacts of its professors with colleagues from such research groups and invites them individually as visiting professors. These are as a rule brilliant scientists – experts in fields selected based on the achievements of the leading branches of science and economic interests.

SUPERVISION

Master theses and doctoral dissertations are the main part of the studies at the IPS. The quality of conceptualising the topic of a master thesis or a doctoral dissertation is therefore at the centre of all student interactions with their professors and especially their supervisors.
Supervision initiates the moment students first come to the IPS, when they start discussing their "tailored studies", generally in breakthrough research fields or in fields that are economy- and development-oriented. It starts with the conceptualisation of the research topic, which is then discussed by the Study Commission and approved by thy IPS Senate and concludes with carefully monitoring the realisation of the master thesis or doctoral dissertation. Special attention of the IPS is therefore devoted to the supervisor selection procedure which takes place in two phases. The first supervisor helps the student as a mentor before the enrolment, especially in outlining the individually selected study programme and monitors the student during the first semester. After that, the student can keep the same supervisor or select a new one. If the topic covers several specific fields, the student is appointed one or more co-supervisors. If the topics are directly development-oriented, the students are also appointed supervisors from the industry who help direct their research work systematically and apply their achievements into practice in real time.

QUALITY OF THE TEACHING STAFF

The quality of most professors and assistant professors at the IPS is at an enviably high level according to scientific criteria. The same goes for their participation in national and international projects, whereas a lot of them are still gaining experience in directly transferring the research achievements into practice. To this end, we enhanced our collaboration with the industry and the service sector. Continuous professional development, both in teaching and in scientific research, is a necessary component of the work of higher education teachers at the IPS. For pedagogical development, the IPS offers its teachers specific training in higher education didactics and encourages international mobility.

The IPS regularly monitors the work of its professors by:

- assessing the scope and quality of their scientific publications in internationally renowned scientific journals and the scope of their citations – with a special emphasis on including the research achievements of IPS students,
- monitoring the participation of IPS supervisors and students in national and international projects,
- supporting the collaboration of IPS professors with the industry, especially regarding target-oriented R&D projects, and protecting the intellectual property of their achievements,
- evaluating, with the help of committees, the interim results of the research and educational process for each student at research seminars held in each study year, and giving assessment and pointers for future work,
- regularly monitoring the work of supervisors within the framework of the Programme and Central Study Commissions with special committees designated for this purpose, from conceptualising the topic of doctoral dissertations to gradually realising the set-out plans and finally assessing the quality of the submitted dissertations.

The teacher : student ratio at the IPS is usually higher than 1 : 2.

An essential quality characteristic is that students work in the supervisor's research group and the supervisor is usually available to them day-to-day.

The quality of most of the IPS professors and assistant professors is at an enviably high level by scientific criteria, likewise regarding their involvement in major national and international projects.

Every year, our professors receive prestigious awards or prizes.

In the academic year 2022/2023 the IPS processed:

6 master thesis topic proposals,
36 doctoral dissertation topic proposals,
13 master thesis proposals, and
36 doctoral dissertation proposals,

- anonymously surveying the students at the end of each academic year regarding the quality of the IPS teaching staff and informing all the participants of the outcomes. If the given results show less than 80 % of the maximum quality assessment (below 4 out of 5), the IPS Dean carries out individual interviews with the concerned parties and addresses the problems in board meetings. In the 2019/2020 academic year, the questionnaire was updated with new questions which were improved based on acquired experience. The results of the questionnaire for the 2022/2023 academic year were the following:
  the average score of the professors was 4.68,
  and the average course grade was also 4.68.

OUTSTANDING ACHIEVEMENTS AND AWARDS RECEIVED BY PROFESSORS IN 2022/2023

Prof. Dr. Igor Križaj – Zois Award for outstanding achievements in toxicology.

Prof. Dr. Uroš Cvelbar - Zois Award for outstanding achievements in the field of plasma physics.

Dr. Tina Kosjek with colleagues - ARRS Excellence in Science 2023 award in the field of environmental protection for the paper "We identified 74 biomarkers of exposure in Slovenian children's urine by non-targeted analysis".

Prof. Dr. Uroš Cvelbar and Prof. Dr. Aleksander Zidanšek with colleagues - ARRS Excellence in Science 2023 award in the field of electronic components and technologies for their paper entitled Recognition of bacterial DNA with an advanced nanoplasmonic sensor.

Prof. Dr. Kristina Gruden with colleagues - ARRS Excellence in Science 2023 award in the field of biotechnology for her contribution "Towards learning the principles of gene regulation in plants".

Prof. Dr. Saša Novak - received the honorary title Communicator of Science, awarded by the Slovenian Science Foundation.

Dr. Neelakandan Marath Santhosh - Jožef Stefan Golden Emblem Prize for his contribution Plasma-enabled design of hybrid carbon nanostructures for energy storage.

Dr. Katarina Bačnik - received the Silver Award of ZRC SAZU for the most outstanding doctorate for 2023, for her doctoral dissertation carried out in the framework of her studies at the IPS.

Assoc. Prof. Dr. Denis Kutnjak with colleagues - ARRS Excellence in Science 2023 award in the field of biotechnology for the paper entitled "Resource-based research for the discovery of unknown diversity of plant viruses in agricultural ecosystems".

Dr. Gregor Primc - author of a highly cited WoS paper, ranked in the top 1% of academic papers in biology and biochemistry (https://doi.org/10.1016/j.ibiotech.2020.04.003).

Dr. Léonard Jean Moriau - Pregl Award for his doctoral dissertation on nanocomposites as electrocatalysts for use in fuel cell and electrolyser reactions. Supervisor of the thesis was Assoc. Prof. Dr. Nejc Hodnik.

Dr. Ana Oberlintner - Pregl Award for her doctoral dissertation entitled Surface modifications of cellulose nanomaterials: mechanisms, kinetics and their applications. The thesis was supervised by Assoc. Prof. Dr. Uroš Novak and co-supervisor Assoc. Prof. Dr. Blaž Likozar.

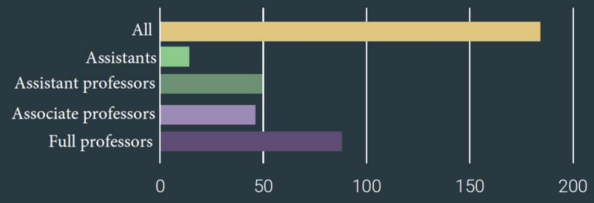
Prof. Dr. Peter Glavič - recipient of the Lifetime Achievement Award in the pedagogical field, Faculty of Chemistry and Chemical Technology, University of Maribor.

Dr. Špela Baebler - recipient of the Miroslav Zei Award for outstanding achievements in scientific research at the NIB and the Golden Pear quality label for the book Charming Experiments with Plants (together with co-editors M. Pompe Novak and M. Dermastia).

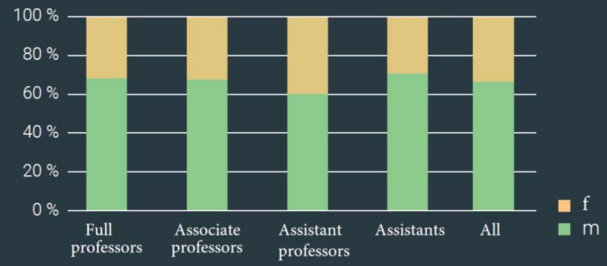
Assoc. Prof. Dr. Mojca Otoničar, Assoc. Prof. Dr. Mirela Dragomir and Prof. Dr. Tadej Rojac - Edward C. Henry Award of the American Ceramic Society for outstanding contribution in the field of electronic ceramics, published in the Journal of the American Ceramic Society.

Dr. Timotej Turk Dermastia - Fulbright Postdoctoral Fellowship in the USA, where he is currently researching in the laboratory of Prof. Kay Bidle in the Department of Marine and Coastal Sciences at the prestigious Rutgers University.

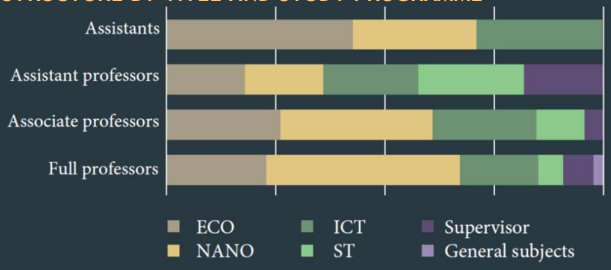
STRUCTURE BY TITLE



STRUCTURE OF HIGHER EDUCATION TEACHERS BY SEX



STRUCTURE BY TITLE AND STUDY PROGRAMME

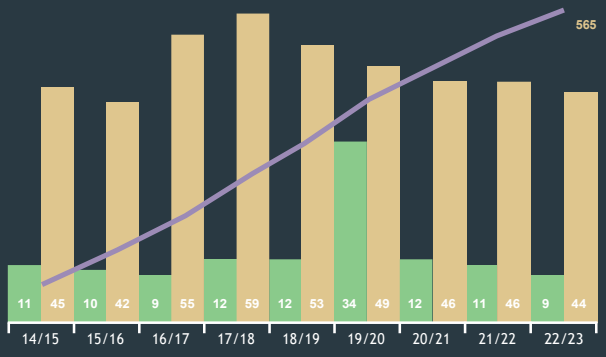


IPS Students

The school informs potential students about the studies at the IPS through responsible government institutions, media, invitations to IPS and JSI Open Days, IPS research and industrial partners, and, most efficiently, through personal contacts among potential candidates, students and the teaching staff.

STARTING THE STUDIES

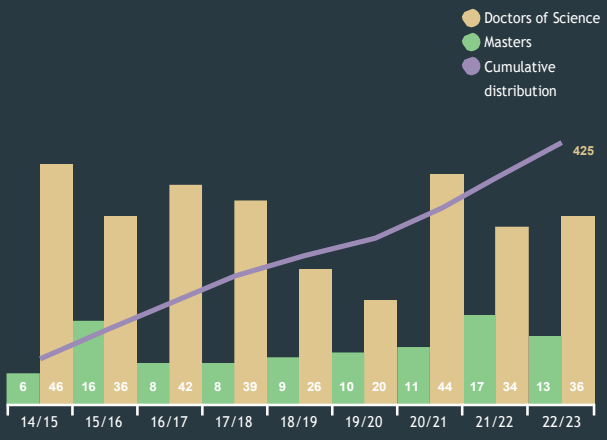
The IPS predominantly enrols students with considerable achievements from their undergraduate studies – the average for all students on first enrolment at the IPS in the academic year 2022/23 was close to 9.0, with 8.93 for doctoral studies. However, undergraduate achievements are not the only criteria. The school holds systematic interviews with candidates for enrolment where we assess their creative disposition and research talent. An important role is also played by their potential employers, especially in the field of research and economy.



The graph shows the number of students enrolled in doctoral and master programmes, and the total per year.

GRADUATION

The quality of master theses and especially doctoral dissertations at the IPS is high. The quality of the study implementation is at European or global level, as proven by student achievements, publications in high quality scientific journals and patents.



The graph shows the number of completed master and doctoral studies, and the total per year.

The average grade from undergraduate studies of newly enrolled doctoral students per academic year:

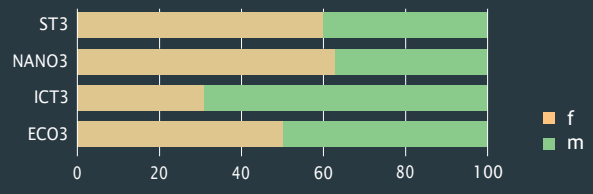
- 2014/2015 8.76
- 2015/2016 8.78
- 2016/2017 8.71
- 2017/2018 8.75
- 2018/2019 8.85
- 2019/2020 8.78
- 2020/2021 8.97
- 2021/2022 8.99
- **2022/2023 8.93**

Average time needed to complete the studies (applies to 2022/2023):

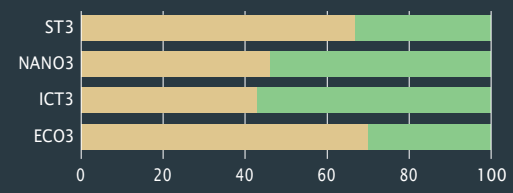
- doctoral studies: **5.14 years**
- master studies: **2.53 years**

STRUCTURE OF STUDENTS BY SEX IN 2022/2023

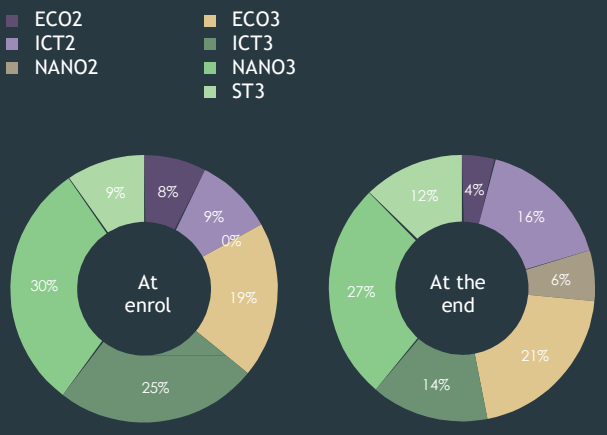
Doctoral students at enrolment:



Doctors of Science at the end of study:



STRUCTURE BY STUDY PROGRAMMES IN 2022/2023



STUDENT COUNCIL

The Student Council is an official body of the Jožef Stefan International Postgraduate School (IPS), as defined in the IPS Statute, and therefore participates and takes equal part in joint decision-making in the IPS Senate, Academic Council, and Governing Board sessions. The Student Council has the right and duty to give opinion and take part in joint decision-making regarding all matters related to the rights and duties of students.

The Student Council consists of 12 elected representatives of students who select two representatives from among the members as the president and the vice-president.
The Student Council organised a wide range of extracurricular activities, namely:

- board games (on-line and in person),
- ice skating,
- hike to Rožnik,
- opening of the academic year,
- visits to companies,
- Student Week,
- Dean's Day and IPS picnic,
- Diploma Ceremony for PhD and master graduates, and full professors,
- IPS Day,
- IPS Open Day,
- participation in the Jožef Stefan Days,
- participation in the Researchers' Night,
- lectures and workshops.

The main event was the 15th Jožef Stefan International Postgraduate School Students' Conference (IPSSC), which took place at the Mekinje Monastery in Kamnik. The conference tagline "Turning problems into solutions" guided students to present their work as part of a solution to a problem that scientists or wider society are facing. Before the conference, students were invited to several workshops on writing abstracts and preparing presentations to help them communicate their research effectively. The location of the conference on the periphery of Kamnik, in the village of Mekinje, was perfect for the conference, as it is a beautiful location with a history dating back to the 1300s, surrounded by lush greenery and peaceful surroundings. The IPSSC brought together postgraduate students from various fields, ranging from ecotechnology, nanosciences and nanotechnology, sensor technologies, information and communication technologies, biotechnology, medicine and other life sciences. More than 70 postgraduate students presented their research work in interesting oral and poster presentations. At the end of the conference, prizes and awards were announced. A committee of IPS academic staff selected the papers that received the IPS Award for the best paper in the four thematic areas (Nanosciences and Nanotechnologies, Ecotechnologies, Sensor Technologies, Information and Communication Technologies). The awards went to Anja Ilenič, Peter Nimac, Cathrine Terro and Anja Pavlovič, whose presentations were the best solutions to pressing problems in our society. The conference was an excellent networking opportunity for young researchers, professors and industry representatives, who also financially supported the event.

EMPLOYMENT PREPARATIONS

The IPS prepares its students for employment from the very beginning. Employment is an important conversation topic from initial enrolment interview and the first meeting with a potential supervisor. Consequently, it also helps design the student's curriculum. The emphasis is even stronger when selecting the topic of a master thesis or a doctoral dissertation which is usually at least roughly related to the future employment of the candidate. The IPS offers its students possibilities of establishing direct contact with founders and partners from the industry and organises activities designated for this purpose (arranging visits of students and their supervisors to the industry, holding talks with responsible development officials in the economy and the service sector, organising meetings with IPS students and potential employers, etc.).

Employment of IPS graduates:
out of 36 PhD students that completed their studies in 2022/2023, 31 are employed in Slovenia, 3 abroad, and for 2 we do not hold data.

- Number of countries where they are employed: **4** (Slovenia, Croatia, North Macedonia, Spain).
- Number of graduates who are employed in companies: 2.
- Number of graduates who are employed in top foreign universities and research institutions: **1**.

In the framework of the Erasmus+ project RESPO X, in which the IPS Career Centre participates, and in cooperation with higher education institutions from the Netherlands, Belgium and Spain, the IPS organised a one-week workshop on the use of an online expert tool to monitor the development of students' competences. The workshop at the Universitat Politècnica de Catalunya (UPC) in Barcelona was also attended by IPS students, and some IPS professors participated as lecturers in three modules: sustainability, STEM and digital. As part of the RESPO-VI project, funded by the Norway Grants, two important studies were carried out at IPS. In the first study, we worked together with the Norwegian university NTNU to produce a report on competences needed in the labour market. The report includes the results of a comparative analysis of responses to questionnaires from Slovenian and Norwegian companies where students of selected IPS study programmes could also be employed. In the second study, we examined the state of digital literacy among HE staff, focusing on the importance of advanced digital technologies in the HE education process. These experiences will further contribute to the organisation of training and optimisation of education for students, who will be given the opportunity to develop career competences and soft skills to enhance their employability.

SCIENTIFIC RESEARCH EXCELLENCE OF STUDENTS

IPS students are systematically encouraged to write scientific articles in respected international journals, scientific conference contributions, abstracts of scientific conference contributions and independent scientific papers or chapters in monographic publications, patent applications, project proposals, research reports and publications of research achievements.

PUBLICATIONS

The newspaper DELO analysed data from eight Slovenian universities and postgraduate schools (published on 23 August 2019) and found that the highest average number of publications per new PhD is at the IPS. A detailed look at the number of published articles shows that the average number of articles is 4 per PhD over a four-year period, which is well above the average for most universities in the field of postgraduate studies. It is particularly significant that more than half of the articles were published in international journals with impact factors, which contributed to the high number of citations. Articles by IPS students and professors have also been published in the journals with the highest impact factors - Nature and Science.

In the academic year 2022/2023, 36 PhD students have published a total of 114 scientific articles in the last 5 years until the end of their studies at the IPS, where they have acted as a corresponding author. On average, each PhD student has contributed to 8.33 JCR publications. The average impact factor (IF*) of the journals in which IPS PhD students have published is 5.792. If we only consider papers where they were the lead author, this IF value is even higher, at 7.194. As many as 23 PhD students have published a first-authored paper in journals with an IF greater than 5, including 9 in journals with an IF greater than 10:

- Trends in Food Science & Technology (IF=15.3),
- ACS Catalysis (IF=12.9),
- Water Research (IF=12.8),
- Trends in Environmental Analytical Chemistry (IF=11.2),
- Carbohydrate Polymers (IF=11.2),
- Journal of Cleaner Production (IF=11.1),
- Nano Letters (IF=10.8).

On average, each PhD student published 2.39 scientific papers and 14.31 abstracts at conferences. 2 PhD students were involved in the granting of 4 patents or patent applications.

The excellence of PhD students is also reflected in the h-index and citation rates of their work in Scopus and Web of Science (WoF). The average h-index per IPS PhD student, which shows the ratio of the number of publications to their citation rate over the last 10 years, was 5 in 2022/23, and two PhD students achieved an h-index even higher than 10. This shows that PhD students have an average of five publications, each of which has at least five citations. The average citation rate per PhD student is 89 in the Scopus database, slightly lower in the WoS database at 85, indicating that PhD students' work is attracting attention from other researchers and is being cited in other scientific journals. The high h-index and citation rate of PhD students is a good indication that their work is not only numerous but also influential and contributes significantly to the scientific literature. In evaluating the performance of PhD students, we have considered data from the SICRIS system.

Trends in Food Science & Technology (IF=15,3)

ACS Catalysis (IF=12,9)

WaterResearch (IF=12,8)

Trends in Environ. Analytical Chemistry (IF=11,2)

Carbohydrate Polymers (IF=11,2)

Journal of Cleaner Production (IF=11,1)

Nano Letters (IF=10,8)

Study programme	Number of PhD students	Avg. h10	Max. h10	Avg. CI (Scopus)	Avg. CI (WoS)	ALL CI (Scopus)	ALL CI (WoS)	Number of JCR Publications per PhD	Number of first-authored paper per PhD	All first-authored papers	Avg. IF_{max} of journals for first-authored papers	Publication with IF_{max}
ECO	10	5	14	116	121	1157	967	10,20	3,50	35	8,840	15,3
ICT	7	3	5	41	29	287	202	3,86	3,43	24	5,071	8,7
NANO	13	5	12	103	107	1343	1174	8,92	2,69	35	7,338	12,9
ST	6	5	7	71	65	427	387	9,17	3,33	20	6,617	10,8
All	36	5	14	89	85	3214	2730	8,33	3,17	114	7,194	15,3

** the analysis is performed on all publications of PhD students in the last 5 years before the end of their studies, 2018/19-2022/23, based on data from the SICRIS database (for those PhD students who are not registered in SICRIS, the data are taken from the dissertation and the SCOPUS database).*

** The IF of journals is summarised for 2022.*

STUDENT PROJECTS

Students are involved in national and international research or development projects and programmes, as well as in direct projects of the IPS with founding partners and other economic partners. In the projects or programmes, they work closely with their supervisors and other members of the supervising and research team.

Analysing the annual reports on the individual research work of IPS students in the 2022/2023 academic year, IPS students participated in more than 45 international projects under Horizon 2020, Horizon Europe, ITN, Interreg Danube, Interreg Central Europe, EIT Raw Materials, EIT Urban Mobility, LIFE, COST, ESA, Euphresco, Erasmus+, INEA and others. Students' research work is also linked to several national projects under ARIS, Ministry of the Environment, Climate and Energy (MOPE), RRI, Ministry of Defence (MORS) and other programmes and calls for proposals. Some students are also involved in industrial projects (Luka Koper, Zavod za gradbeništvo, FH-Kooperativ).

ACUITY	CONDUCTOR	FLADO-VIGILANT	INQUIRE	QU4LITY	RIS Hub Slovenia
ADAPT	Cool BatMan	FNS-Cloud	INSPIRES	ReBuilt	STAR
BD4OPEM	CORA-2023-GBF-002	FoodTraNet	INTREPID	RECO2MAG	TERMITRAD
BUILDCHAIN	CREATORS	GMOS-Train	MaCoCu	ReconCycle	TIMEPAC
CARE4 CLIMATE	Danube Hazard m3c	Grant No 57588366	NAIADES	RECOVER	TunTWIN
CastQC	EnRichMyData	HEO4CAT	Noč ima svojo moč	REEsilience	URBANITE
CLARIN ERIC	ERBFacility	HiPeR-F	ODEUROPA	RESOLVE	URBANOME
CLEOPATRA	FishEUTrust	INEXTVIR	PARC		

IPS Awards for Outstanding Achievements

At the Diploma Ceremony for new Doctors of Science and professional Masters who completed their studies in the first half of 2023, the Jožef Stefan International Postgraduate School (IPS) also awarded recognitions for outstanding achievements. These awards cover a broader period, as many results included in the doctoral dissertations were published in top scientific journals even after the defense.

GOLD CERTIFICATE OF DISTINCTION FOR OUTSTANDING THESIS "SUMMA CUM LAUDE"

is the highest level of award for students who have achieved outstanding academic success and demonstrated exceptional knowledge, dedication and intellectual excellence in their study programme. The certificates were awarded to Dr. Ana Kovačič, Dr. Neelakandan Marath Santhosh, Dr. Lidija Strojnik, Dr. Blaž Škrlj and Dr. Martina Štampar.

CERTIFICATE OF RECOGNITION FOR EXCEPTIONAL CONTRIBUTION TO THE DEVELOPMENT OF EXTRACURRICULAR ACTIVITIES AT IPS

was awarded to students Nina Kuzmić, Rok Novak, Cathrine Terro, Mark Zver and Klara Žagar. Nina Kuzmić, a graduate of the Nanosciences and Nanotechnologies programme, said she was extremely grateful and honoured. "This reflects the values of the school, which recognises the effort and time that students voluntarily devote to studying, collaborating, organising workshops and events - the most prominent of which is the IPSSC Student Conference, which is growing rapidly year after year."

CERTIFICATE OF RECOGNITION FOR EXCEPTIONAL PROFESSIONAL WORK THAT CONTRIBUTED TO THE DEVELOPMENT AND ACTIVITY OF THE SCHOOL

was awarded to Prof. Dr. Aleksander Zidanšek, Vice-Dean for Study Matters of the IPS.

IPS GOLDEN EMBLEM

was awarded to Dr. Jožica Rejec and Radovan Bolko, long-standing members of the School's Management Board and Assembly. They received the award for their outstanding merits in the development and promotion of the IPS at home and abroad, and for their significant successes in the field of education and research, which have contributed significantly to the reputation of the IPS.

JANEZ VAJKARD VALVASOR MEDAL

is an honour awarded by the IPS to individuals from IPS partner organisations for their long-term development vision and outstanding achievements in developing innovation, by directly linking basic research achievements in joint development projects with the IPS involving human resources development at postgraduate level. This year's recipient of the honorary award was Dr. Tanja Ljubič Mlakar.

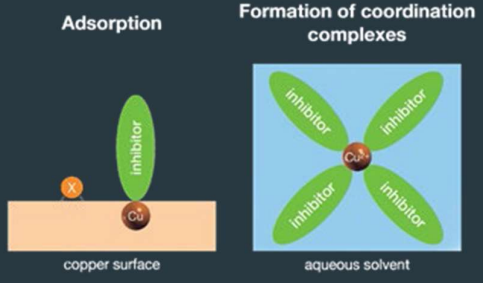
Student Achievements

NANO STUDENT ACHIEVEMENTS

MATJAŽ DLOUHY

used a density functional theory-based molecular modelling approach in his doctoral dissertation. He focused on the basic processes associated with the pressing phenomenon of corrosion. He studied the interactions of azole corrosion inhibitors with the copper surface and hydrated Cu(I) and Cu(II) ions. He investigated the effects of chemisorbed hydrogen, oxygen, hydroxide and chloride on the adsorption of imidazole and benzotriazole. These chemisorbed species are normally present on metal surfaces during corrosion. He found that the chemisorbed oxygen atoms significantly stabilise the adsorption of the inhibitor molecules and promote their deprotonation on the surfaces, leading to even stronger adsorption. This increases the persistence of the inhibitor molecules on the surface, which is crucial for their inhibition activity, since the inhibitor molecules must persist on the surface to inhibit corrosion. In a study of hydrated Cu(I) and Cu(II) ions, he modelled the formation of coordination complexes with 19 N-heterocyclic molecules. The formation of such complexes can be seen as the opposite of molecular adsorption, since the former accelerates, and the latter inhibits corrosion. He showed that most of these molecules can form stable soluble coordination complexes with copper cations, excluding benzotriazole, which is a very effective corrosion inhibitor. The results obtained in the framework of the doctoral dissertation have so far been published in two papers in Corrosion Science, a reputable journal in the field of corrosion.

DOI: https://doi.org/10.1016/j.corsci.2022.110443, https://doi.org/10.1016/j.corsci.2022.110680.



BARBARA REPIČ

participated in the CrossNano 2023 cross-border workshop for PhD students in nanosciences and nanotechnology, held at the University of Trieste. She received the "Alessandro De Vita" award for the most multidisciplinary research work and the most scientifically curious student for her paper entitled "Graphs of screen-printed electrode for electrochemical detection of imidacloprid" by Barbara Repič, Maksimiljan Dekleva, Darko Belavič, Kostja Makarovič, Mitja Jerlah, Ema Gričar, Helena Prosen, Mitja Kolar, Gregor Marolt and Danjela Kuščer Hrovatin. Her research focuses on the development of miniature sensors for the electrochemical detection of pesticides from the neonicotinoid group. These synthetic pesticides are used in agriculture and have harmful effects on pollinators such as bees, as well as on human health. The monitoring of neonicotinoids in the environment and in food requires the development of miniature sensors that detect neonicotinoids at the point of contamination, rapidly and with a low detection limit. In this paper, Barbara Repič presents the preparation and characterisation of the operating electrode, a corundum-based graphene layer. She also reported on the fabrication of a miniature electrochemical sensor system with integrated working, reference and counter electrodes and electrical connections on corundum. She demonstrated that such a system is suitable for the detection of neonicotinoids and has a reproducible response.

KLARA KURET

studies the molecular biology of RNA, in particular the changes that are reflected in the development of a wide range of diseases, from cancer to neurodegenerative conditions. In her PhD, she is using computational approaches to investigate the cellular interactions between RNA and proteins, which play a key role in regulating gene expression and are thus of paramount importance for normal cell function and tissue development. Disruption of these contacts often accompanies the development of diseases, especially neurodegenerative diseases. Knowledge of the mechanisms of protein-RNA contact formation in different physiological and disease states can thus reveal yet unknown mechanisms of disease initiation and progression, as well as normal development. In 2023, she was awarded the L'Oréal-Unesco National Programme for Women in Science Fellowship.

ŽIVA MARINKO

investigated in her doctoral dissertation the relationship between the synthesis and properties of anodic oxidised layers on titanium substrates for use in photocatalysis. The use of TiO_2 represents a favourable solution for the degradation of organic pollutants in wastewater and air. In the system, it represents a non-toxic and inert medium which, under UV illumination, forms reactive oxygen compounds directly responsible for the mineralisation of pollutants. TiO_2 nanotubes can be produced by various synthesis methods, with electrochemical oxidation (anodic oxidation) being the optimal process due to its versatility. The present study addressed three aspects of TiO_2 nanotubes; synthesis on different titanium substrates, optical properties under UV light and photocatalytic performance in the degradation of a model organic compound. The results of this basic research are suitable for direct application in the industrial sector. The results of the PhD work have been published in Catalysts and ACS Omega journals and at various scientific conferences in Europe.

DOI: https://doi.org/10.3390/catal10070803, https://doi.org/10.1021/acsomega.1c02862

ICT STUDENT ACHIEVEMENTS

LJUPCHO MILOSHESKI

published a paper entitled "Self-supervised Learning for Clustering of Wireless Spectrum Activity" in the prestigious journal Computer Communications. The paper focuses on the challenges posed by the non-deterministic nature of real-world wireless spectrum data, which makes traditional supervised learning approaches based on labelled data time-consuming and expensive. The focus is on the use of self-supervised learning (SSL) as an alternative to supervised learning and the evaluation of its performance in real-world scenarios with unlabelled data, with the main challenge being to maintain a balance between the performance and the complexity of the solution. Adapting the architecture of SSL to domain data led to a significant reduction in the complexity of the model and in some cases even improved its performance. Thus, the paper has shown that SSL is a practical and efficient approach to analyse wireless spectrum occupancy in realistic scenarios.

DOI: https://doi.org/10.1016/j.comcom.2023.10.009

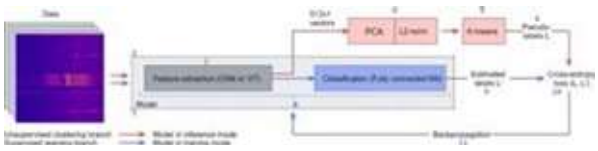
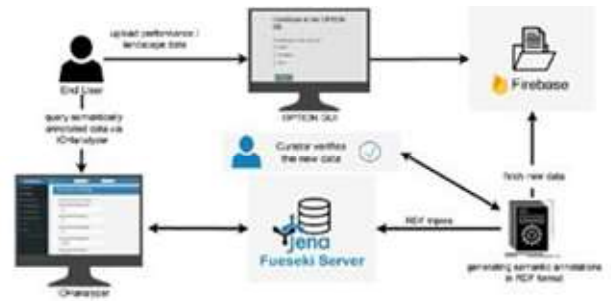


Figure: System architecture. Published in L. Milosheski, Self-supervised Learning for Clustering of Wireless Spectrum Activity. Computer Communications, 2023.

ANA KOSTOVSKA

and colleagues Dr. Sašo Džeroski and Assoc. Prof. Dr. Panče Panov from the Department of Knowledge Technologies, and Assoc. Prof. Dr. Tome Eftimov from the Department of Computer Systems of the Jožef Stefan Institute recently published a paper entitled OPTION: OPTImization Algorithm Benchmarking ONtology in the top computer science journal IEEE Transactions on Evolutionary Computation with an extremely high impact factor (JCR IF = 16.4). The work presented here is the result of a collaboration with external partners from Sorbonne University, France, and Leiden University in the Netherlands. The paper focuses on the development of an ontology that allows the semantic annotation of the key entities of benchmarking of optimisation algorithms based on evolutionary computation, enabling a systematic way of sharing and reusing the huge amounts of data generated by comparative studies. The development of the OPTION ontology is a step towards improving the reusability and interoperability of data on benchmarking in the field of optimisation. It follows the principles of open science and contributes to best practices in open computational science.

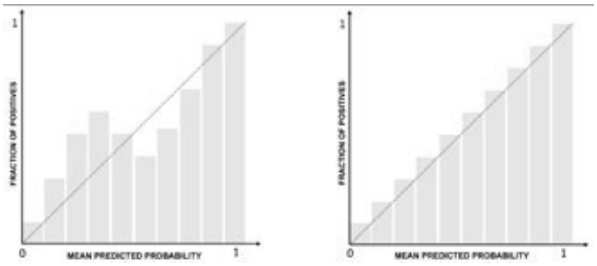
DOI: https://ieeexplore.ieee.org/document/10002940



JOŽE ROŽANEC

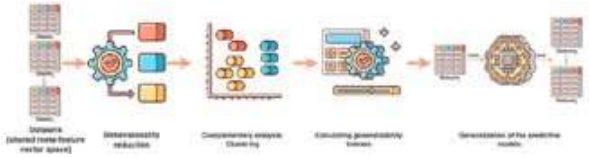
In the paper "Active learning and novel model calibration measurements for automated visual inspection in manufacturing", published in Springer with an impact factor above 8.0, he and his co-authors proposed a new metric in the field of probability calibration of machine learning models and an approach for detecting quality bias in probability calibration with unlabelled data. The metric assumes that the distribution of the predictions is known when they are ideally calibrated. Based on this, the necessary input to give an ideal distribution to the existing calibration can be calculated. In this way, the proposed metric addresses the shortcomings that can be detected in commonly used metrics in this field. The approach for detecting the quality of the unlabelled probability calibration solves an important problem in applied machine learning: as the distribution of the data changes, so do the predictions of the machine learning models. It is therefore crucial to detect deviations of the predictions from the original distribution, as such deviations may mean that the probability estimates of the original calibrations no longer reflect reality. Detecting such deviations is crucial in many industries (e.g. medical diagnostics or forecasts of credit defaults). The author tested the metrics and approach on an industrial example of manufacturing defect detection on real data from Philips. The proposed metrics and approach represent a step forward in this field of machine learning.

DOI: https://doi.org/10.1007/s10845-023-02098-0



GORDANA ISPIROVA

In her doctoral dissertation "Exploiting Domain Knowledge in Predictive Learning from Food and Nutrition Data", she addressed the importance of using domain knowledge in the process of predicting nutritional values from unstructured recipe text. The dissertation describes a machine learning prediction process that exploits domain knowledge to improve the desired outcome: more accurate predictions of nutritional values. The ML pipeline evolves through the chapters to include new and more robust features that improve not only the results but also the generalisability power of the overall method. The presented work has led to her obtaining a postdoctoral position at Harvard University in the USA.



GREGA MORANO

is involved in the field of Integrated Sensing And Communications (ISAC), researching how localisation functions can be seamlessly integrated into the IEEE 802.15.4 Time Slotted Channel Hopping (TSCH) communication protocol. He has proposed two new innovative methods for distance estimation. The two methods determine the distance by Multi-Carrier Phase Difference (MCPD), which estimates the distance between two devices with each data packet sent. To improve and refine the state-of-the-art phase distance estimation algorithm, a comprehensive solution that reduces power consumption while maintaining the accuracy and sensitivity of the estimated distances has been developed, implemented and verified. He implemented the proposed methods in the Contiki-NG operating system. The impact of the proposed solution on communication, range performance and energy consumption were evaluated by measurements in a real environment. The results show that the proposed method can estimate the position with a median error of 0.26 m and an accuracy of 0.31 m for indoor scenarios and a median error of 0.05 m and an accuracy of 0.05 m for outdoor scenarios. The proposed further improvement of the algorithm additionally improves the time efficiency and reduces the power consumption of the distance estimation technique. The results of the research were published in the prestigious IEEE Internet of Things Journal.

DOI: https://doi.org/10.1109/JIOT.2023.3330933

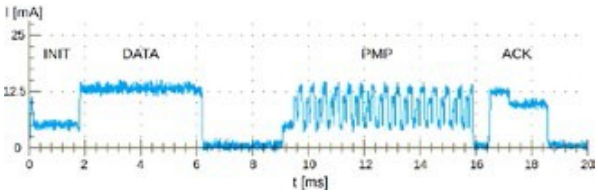
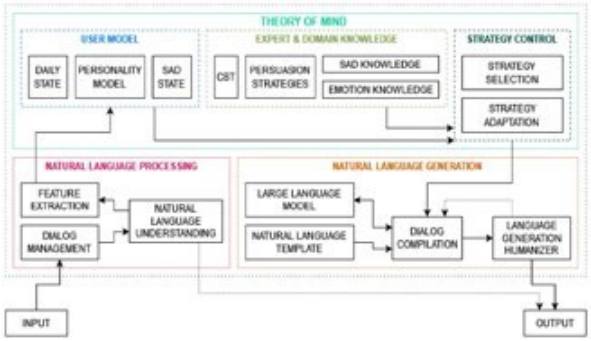


Figure: Energy consumption during measurements. Published in G. Morano et al. Phase-based distance estimation integrated with IEEE 802.15.4 TSCH communication. IEEE Internet of Things Journal, 2023.

TINE KOLENIK

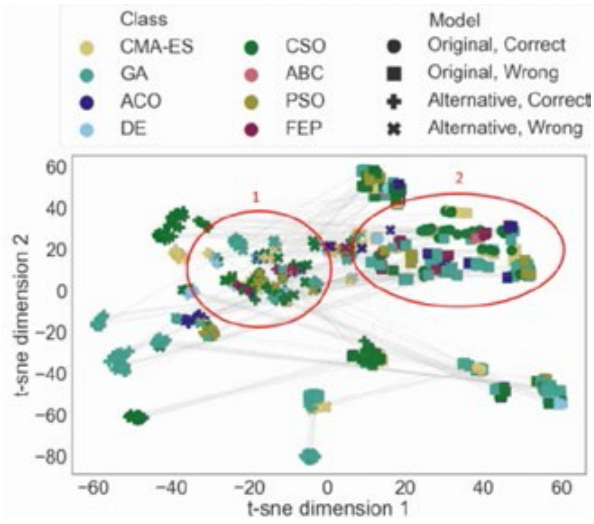
is building an intelligent cognitive system for computational psychotherapy with a conversational agent to change attitudes and behaviour in stress, anxiety and depression. To this aim, he has compiled a novel database that includes panel data covering multiple individuals across multiple time series. It includes 1495 cases of quantified levels of stress, anxiety and depression and symptom ratings obtained from diagnostic questionnaires accompanied by qualitative diary entries. This database, in addition to new domain ontologies, uses an artificial cognitive architecture built to simulate theory of mind - the cognitive ability to understand others and consequent appropriate behaviour. The simulation is methodologically performed by cognitive modelling and machine learning models. The system is compatible with large language models (e.g. GPT-4), which through the system work better in the mental health domain. He published descriptions of the architecture and excerpts of his work in various academic contexts, including in the chapter "Methods in Digital Mental Health: Smartphone-Based Assessment and Intervention for Stress, Anxiety, and Depression" in a Springer book and the article "Intelligent Cognitive Assistants for Attitude and Behaviour Change Support in Mental Health: State-of-the-Art Technical Review" in the Electronics journal.

DOI: https://doi.org/10.1007/978-3-030-91181-2_7



URBAN ŠKVORC

graduated with a doctoral dissertation on "Understanding the impact of problem landscapes in numerical optimisation of a black box". He focused on the analysis of optimisation problems using the method of analysis by investigation. In his thesis, he carried out a complementarity analysis of the most well-known optimisation test environments. He showed that the environments contain different optimisation problems, which consequently affect different comparative analysis results of the optimisation algorithms. In the analysis of the space of optimisation problems, he focused on the most commonly used method of landscape analysis for describing the features of optimisation problems, where he examined the influence of the transformations of displacement and scaling on the feature computations. He showed that there are relatively few features that are invariant to these two simple transformations and that they can describe problems relatively well compared to using the full set of features. Finally, he experimentally verified and showed that it is not possible to generalise the predictive performance of the optimisation algorithm with the current set of features for describing the problems. He published the results of his dissertation-related research in several high-impact papers, which also led to an h-index of 5. He is currently a postdoctoral researcher in the Machine Learning and Optimisation Group at the University of Paderborn.



BOSHKO KOLOSKI

and co-authors Timen Stepišnik Perdih, Marko Robnik Šikonja, Senja Pollak and Blaž Škrlj were awarded the Excellence in Science Award for the publication of their paper "Knowledge graph informed fake news classification via heterogeneous representation ensembles" in the Neurocomputing journal. The paper addresses fake news recognition, which is particularly relevant in emergency situations (e.g. pandemics, elections, wars), as only truthful information allows the public to make informed decisions. In this paper, the authors present an original method for efficient automatic detection of fake news in media texts and social network posts. The proposed document presentations consider implicit information from language models such as ChatGPT as well as explicit information from curated knowledge graphs. The paper demonstrates that document presentations with knowledge graphs can exceed the efficiency of traditional learning methods.

DOI: https://doi.org/10.1016/j.neucom.2022.01.096

LUKA MIŠKOVIĆ

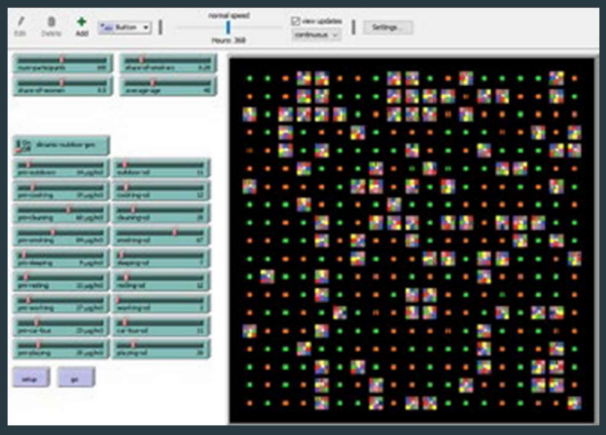
In an article entitled "Pneumatic exoskeleton joint with a self-supporting air tank and stiffness modulation", Luka presented a ground-breaking innovation in the field of exoskeletons: a new pneumatic joint that combines the lightweight design of pneumatic actuators with the robustness of electromechanical systems. The central part of the innovation is the use of a pneumatic artificial muscle, which acts as an air reservoir, and a pneumatic cylinder to store and reuse energy. A key feature of the technology is variable stiffness, which is adjusted by adjusting the pressure in the pneumatic cylinder and by varying the length of the pneumatic artificial muscle. This system has been analysed in detail and tested on an experimental platform, verifying its performance, resistance to temperature changes and tightness. The experimental results confirmed the theoretical concepts and showed promising performance, representing an important step forward in exoskeleton technology.

ECO STUDENT ACHIEVEMENTS

ROK NOVAK

developed an agent-based model based on a dataset collected by portable personal monitors. Combining air quality data, biometric data and detailed activity information of individuals, a simple digital twin was created to simulate the exposure of individuals to air pollution. A related model based on aggregated population data showed comparable exposure results, allowing validation of the approach. Agents acting as activists to promote active mobility were subsequently included in the model. They represented the cumulative social impact on active mobility decisions. The results showed that an increase in the proportion of these activists starts to have a significant effect on the received particle dosage at high environmental particle concentrations. The approach presents an advanced way of processing data collected through different citizen science approaches and offers a tool for researchers, decision makers and genral public to simulate pollution exposure and particle intakes.

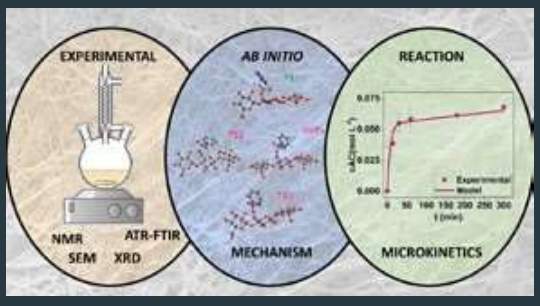
DOI: https://doi.org/10.1016/j.healthplace.2023.103111



ANA OBERLINTNER

published her research work on surface-modified cellulose nanomaterials and their applications, carried out as part of her doctoral dissertation, in ACS Sustainable Chemistry & Engineering and International Journal of Biological Macromolecules (co-first authorship). In the first article, she investigated the mechanisms and kinetics of the acetylation reaction of nanocellulose and developed a microkinetic model by combining experimental and theoretical results. In the second article, thus modified cellulose nanocrystals were used to reinforce chitosan- and alginate-based films, which were then characterised for their biodegradability and degradation mechanism. For her research work, she was awarded the L'Oréal-UNESCO 'For Women in Science 2023' fellowship and the Pregl Prize for outstanding work in chemistry and related sciences 2023.

DOI: https://doi.org/10.1021/acssuschemeng.2c04686
https://doi.org/10.1016/j.ijbiomac.2023.126433



MITJA KELEMEN

has been involved in the development and application of ionic analytical methods. His work mainly concerns the application of ionic analytical methods to the study of processes in materials suitable for fusion reactors. Materials in fusion reactors are subject to various erosion and impurity deposition processes which affect the lifetime of the components. He has focused on the study of the influence of surface roughness on erosion and impurity retention by ion analytical methods, including in the micro-metre range. Impurities include the retention of hydrogen isotopes in the materials themselves, the dynamics of which can be studied effectively using ionic analytical methods. Together with colleagues led by Dr. Sabina Markelj, they explained the influence of crystal grain size on the rate and magnitude of hydrogen isotope retention in tungsten, an important material for the inner walls of a fusion reactor.

The applicability of ionic analytical methods is also evident in other fields of science (biology, medicine, secondary mass spectrometry, etc.), which has led him to many interesting and fruitful collaborations.

DOI: https://doi.org/10.1016/j.nme.2023.101509

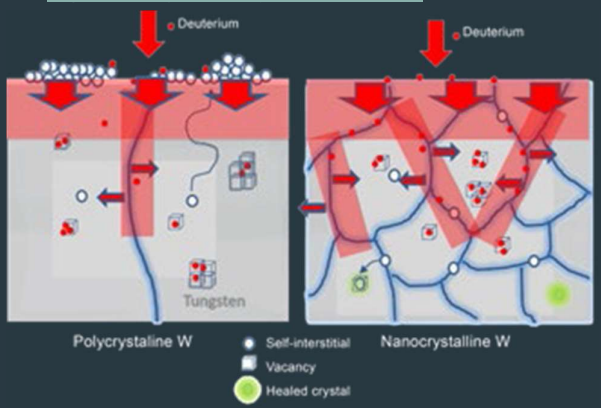
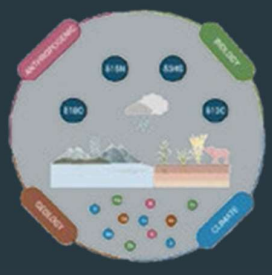


Figure: Hydrogen isotope migration in polycrystalline tungsten.

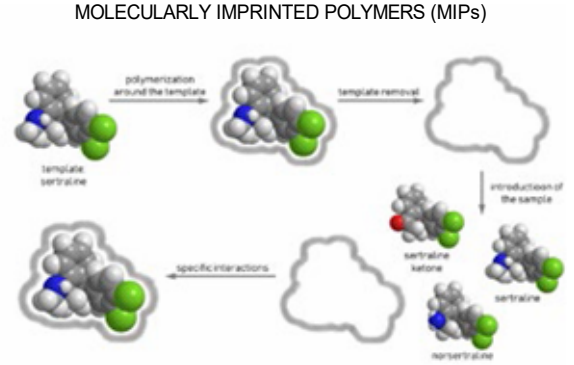
KATJA BABIČ

won the best poster award at the ISO-FOOD conference. Her paper, entitled "Characterization of Slovenian pork meat based on stable isotope ratio, multi-elemental analysis, and multivariate modelling approaches", was awarded for outstanding quality research work. The student is working on the authenticity of the origin of pork meat in the Slovenian market, using isotope and elemental analysis as one of the most powerful approaches to determine the geographical origin, as well as different methods of analysis such as inductively coupled plasma mass spectrometry (ICP-MS) and isotope ratio mass spectrometry (IRMS). The results of her research work are expected to be useful for government agencies in verifying the origin of pork meat, for consumers who want protection against food fraud and for farmers who want to protect their Slovenian pork meat.



TJAŠA GORNIK

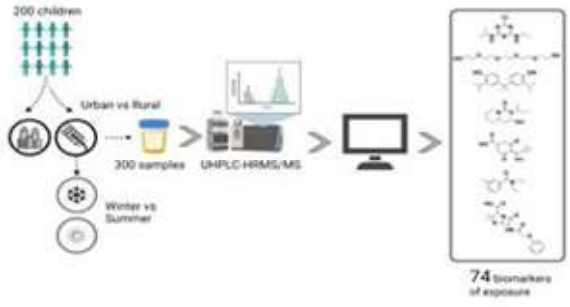
did her research in the field of degradation of pharmaceuticals during wastewater treatment, and synthesised molecularly imprinted polymers to improve their removal during the treatment. She also researched the photodegradation of pharmaceutical residues after they have been discharged from treatment plants and entered aqueous environment. She received several awards including excellent poster presentation award at the 3rd International Caparica Christmas Conference on Sample Treatment.



ŽIGA TKALEC

and colleagues identified 74 exposure biomarkers in the urine of Slovenian children by non-targeted analysis. The achievement highlights the magnitude of children's exposure to mixtures of known and unknown chemicals. Many of these may represent a significant risk factor for children's health. Human biomonitoring (HBM) provides information on patterns, extent, and quantity of human exposure to chemicals. Many of these chemicals have negative impacts on health, making exposure monitoring crucial for human well-being. Typically, we track chemicals with known concern regarding their negative effects, but we know little about those that are not monitored, yet they may pose significant health risks. This study focused on developing a methodology for comprehensive monitoring of exposure to both known and unknown chemicals. Using the developed methodology, we analyzed urine samples from Slovenian children and identified 74 different biomarkers of exposure, revealing not only exposure to expected chemicals but also previously unreported ones. The results indicate a significant extent of children's exposure, including chemicals that pose serious health risks. Consequently, the findings can serve as a basis for developing intervention measures to reduce the impact of chemicals on health. This work is important for the advancement of HBM and contributes to informing the public health.

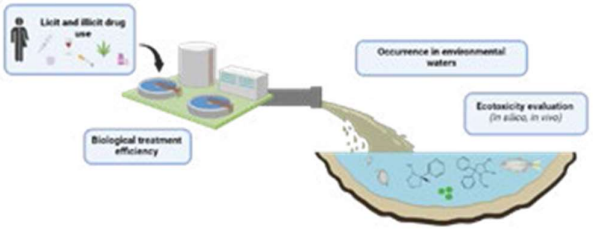
DOI: https://doi.org/10.1016/j.envpol.2022.120091



TAJA VEROVŠEK

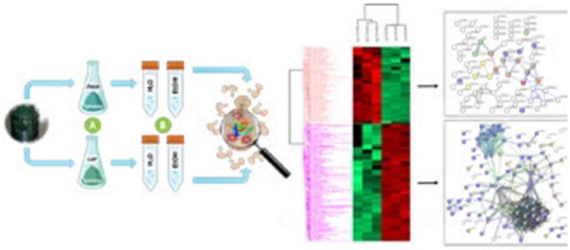
has contributed to a better understanding of trends in illicit and licit drug use in the general population and vulnerable groups such as educational institutions by introducing the epidemiology of wastewater based on its chemical analysis. The results were obtained as part of an international survey under the framework of the Sewage analysis CORe group - Europe (SCORE) network and the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) and showed that illicit drug use in Slovenia is comparable to that in Western and Southern European countries. Drug use is not only a social problem, but also an environmental one. The increasing use of drugs and their incomplete disposal in the context of wastewater treatment means that drug residues are ubiquitous in the environment, where their biological activity is a cause for concern. Taja therefore also looked at the effectiveness of drug residue removal during wastewater treatment processes, the presence of drug residues in environmental waters and their ecotoxicity. Although drug residues were frequently present in most of the investigated Slovenian rivers (ng/L range) receiving treated wastewater and, to a lesser extent, in the groundwater of the Ljubljana Marsh (pg/L-ng/L range), ecotoxicity to the green alga Chlamydomonas reinhardtii was not demonstrated at concentrations higher than the environmental limit (1 mg/L). Taja published the results of her research in nine papers in high-impact factor journals and 12 conference papers, winning two awards for best conference presentation. The impact and relevance of the research for Slovenian society are also reflected in the 18 articles published in various Slovenian media.

DOI: https://doi.org/10.1016/j.scitotenv.2022.161257



JASMINA MASTEN RUTAR

focused in her doctoral dissertation on the quality, safety and authenticity of spirulina products from the Slovenian market, which represents the development and application of proteomics and metabolomics in the food industry. With the approaches used, she investigated the potential of fermented microalgae to combat cellular stress and improve the nutritional value of algal biomass. The impact of fermentation of spirulina biomass and the difference in antioxidant activity was investigated at cellular, proteomic and, more specifically, metabolomic level using yeast as a model organism. She found that ethanolic extracts of fermented spirulina biomass showed higher in vitro and intracellular antioxidant activity and a lower extent of oxidative lipid damage compared to other samples. This type of research contributes to the development of new functional foods in terms of the implementation of new food processing techniques intending to improve their nutritional quality and consequently contribute to consumer health.



SENSOR TECH STUDENT ACHIEVEMENTS

OANA-ANDREEA CONDURACHE

Her research focused on utilising transmission electron microscopy (TEM) techniques to investigate ferroelectric materials at the atomic scale. During the 2022/2023 academic year, she published two papers which targeted the investigation of the dynamics of domain walls in lead-free ferroelectric single crystals. In one publication, she explored how the ferroelectric domains are moving with electric field. Additionally, the other paper demonstrated the polarisation switching and electric field-induced phenomena at the domain wall level with atomic resolution. Because of her work achievements, she was selected to represent Slovenia in the Student Speech Contest at the XVIIIth Conference of the European Ceramic Society in Lyon, France.

DOI: https://doi.org/10.1063/5.0149949
https://doi.org/10.1021/acs.nanolett.2c02857

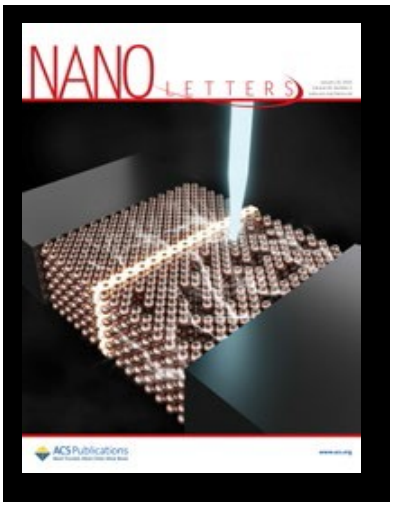
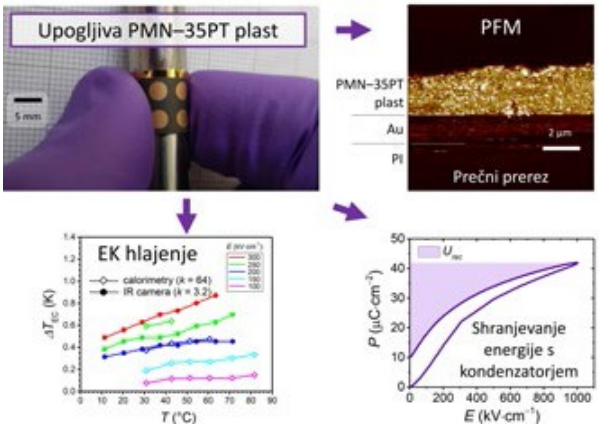


Figure: Ferroelectric domain walls are analysed by in situ voltage bias transmission electron microscopy in a capacitor-like configuration. The response of the walls at the atomic level in the presence of defects shows a unique and complex behavior.

MATEJ ŠADL

and colleagues at the Department of Electron Ceramics of the Jožef Stefan Institute (K5 JSI), in a long-term collaboration with the Luxembourg Institute of Science and Technology (LIST) and the Faculty of Mechanical Engineering of the University of Ljubljana (FS UL), have succeeded in preparing ferroelectric thick films ($0.65Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.35PbTiO_3$), which exhibit multifunctional properties. The application value of the thick films is reflected in their excellent flexibility, in the collection of electrical energy (electromechanical conversion), in the storage of electrical energy (capacitor) and the cooling (by electrocaloric (EC) phenomena).

DOI: https://doi.org/10.1039/D3TC01555F



Social Life at IPS

- Opening of the academic year,
- Dean's Day and IPS picnic,
- Diploma Ceremony for Doctors of Science, Professional Masters and Full Professors,
- IPS Day,
- IPS
- Open Day,
- participation at Jožef Stefan Days,
- participation at Researchers' Night.

Supporting High-Quality Study and Research

ONLINE SUPPORT AND COMMUNICATION

Following the redesign of the IPS website in 2018, the school has started to update its IT system to support administration, students (e-Student) and professors (e-Professor) in August 2021. All stakeholders were involved in the discussions on the development of the updates: staff of the professional services, student and professor representatives, who contributed with their suggestions to the establishment of the new IT system. As this is a complex and holistic project, the work continued in 2022. The new system provided students with a better overview of their study-related activities (timetable and list of enrolled courses, exam dates, obligations fulfilled, documents required for their studies). The new system provided professors with a better overview of the study process (information on students in courses, direct communication with students, editing of materials, overview of activities).

IPS OFFICE

The staff of the IPS office was available to students and professors in person at the office, by email and by phone. The introduction of a more efficient IT system has made it easier for staff to issue documents related to the study process (enrolment certificates, transcripts of records, graduation certificates, exam applications, documents for seminar and thesis defences, etc.) and for students to access the documents they need more quickly. The study process and the teaching work in the academic year 2022/2023 were carried out smoothly, and students and teachers were provided with all the necessary information and documents. Lectures, consultations and defences were delivered in person or in a hybrid manner.

ERASMUS EXCHANGES

In the 2022/23 academic year, 9 IPS students successfully completed short and longer study mobility exchanges at top universities, institutes and international organisations in the Netherlands, France, Germany, Serbia, Spain and the United Kingdom, for a total duration of 11 months.

In the 2022/2023 academic year, a student from Prague was hosted at the IPS for four months and two colleagues from the Institute of Physics in Belgrade were hosted at the IPS for one week. Eight IPS staff members have been hosted by universities in Norway, France, Spain, Switzerland, Turkey and the United States.

RESEARCH EQUIPMENT

Within their research and educational programme, the IPS students have access to state-of-the-art research equipment within the framework of the founding and partner institutes (JSI, IMT, and NIB), and especially within the centres of excellence:

- The Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBiP) and
- Centre of Excellence NAMASTE (Advance materials for the future).

In the scope of the projects designed for industrial partners, the IPS students are also directly involved in their respective research laboratories. The IPS also established its own research laboratory for developing measuring instruments for selective proximity detection of materials.
In this context, the IPS students have access to modern research equipment to work on their research tasks and are provided the expertise of highly qualified research instructors within the framework of expert groups from responsible institutions.

ALUMNI CLUB

The IPS established an Alumni programme. The primary tasks of the IPS Alumni Club are:

- providing study information,
- establishing connections for project work,
- organising visits to institutes and the industry in Slovenia and abroad,
- giving suggestions on how to improve the quality at all levels,
- increasing collaboration with research and industrial partners,
- organising an annual meeting with an excellent expert programme and a more relaxed social gathering.

CAREER CENTRE

At the IPS, we want to complement our teaching activities with a Career Centre, where our students have the opportunity to collaborate with the industry and institutes, to learn about business in the real sector, to become better prepared for the workplace and to gain employment in good companies. We want to ensure that students also participate in and complete research assignments related to current research in the industry as part of their full-time education.
In 2018, the IPS also introduced a new elective course, Industrial Seminar. The Career Centre is involved in the organisation and delivery of a seminar proposed by the participating company on a topic of relevance to the company and the student. In this way, the Career Centre is a point of contact between students, the school, graduates and other employers. The Career Centre also helps future and current students to decide on their studies, coordinates international exchanges, advises on career planning and follows the career paths of its graduates.
The Career Centre also plays an important role in attracting and implementing national and international projects in the field of pedagogy, higher education and skills development of students (e.g. Erasmus+ Strategic Partnerships, Interreg Programmes, Creative Pathways to Knowledge - PKP, Student Innovative Projects for Social Benefit - ŠIPK, Centre of Excellence). The services of the IPS Career Centre are free of charge.

In this academic year, 36 PhD students published a total of **114 scientific articles** with first authorship.

We run **7 international projects**.

Higher education teachers achieved 16 **outstanding achievements** and received excellent awards.

IPS students are involved in more than **45 international projects**.

SUMMARY OF SELF-EVALUATION REPORT FOR 2022/23 ACADEMIC YEAR
Jožef Stefan International Postgraduate School

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