I. IPPT - Activities and development of research in the field of artificial intelligence

1. Description of major research achievements in the scope of implementation of R&D projects, as well as the commercialisation of deliverables of such projects regarding artificial intelligence for the last 5 years prior to or in the year of the application along with a list of the most important publications and patents of the applicant (max. 1 A4 page).

Research in the field of artificial intelligence has been carried out at IPPT PAN for many years, especially in the Department of Information and Computational Sciences (Research Team of Intelligence and Computational Engineering and Research Team of Neuroinformatics), the Department of Intelligent Technologies, the Department of Ultrasound and the Laboratory of Professional Electronics. Significant results confirmed by prestigious publications were achieved in the following areas:

I. Application of AI algorithms to optimal design of engineering systems and classification and clusterization biological and medical data.

The Computational Intelligence and Engineering Team has been working on the development and application of artificial intelligence methods for many years. This applies in particular to the application of **evolutionary and genetic algorithms, artificial immune systems, swarming algorithms and artificial neural networks** to the problems of **optimal design of shapes, topology and material of technical systems and solving inverse problems**. The summary of this research is the monograph: T. Burczyński et al., **Intelligent Computing in Optimal Design. Springer Verlag 2020.** The use of memetic algorithms to design new 2D nanomaterials based on carbon (graphene-like materials) and based on molybdenum are a continuation of this research in the field of materials science. Two research projects are devoted to these issues. Original research on application of artificial immune systems to classification and clusterization of data problems and on the analysis of multidimensional biological data including the analysis of ECG pathogenic signals as well as the analysis of DNA micromatrices with gene expression measurements has conducted. Systems uncertainty models play an important role in AI-related issues. Granular computing based on fuzzy sets in the form of the so-called directed fuzzy numbers and directed random fuzzy numbers are developed to predict financial time series and predict day-ahead spot electricity prices. Another important area is the assessment of intelligent systems in the context of their meeting the criteria of artificial intelligence and the social and ethical consequences of the development of artificial intelligence.

II. Neuroinformatics - Description of the results related to the study of neural networks inspired by the architecture of the brain, artificial brain, new generation computers - Application of Information Theory (TI) and Artificial Intelligence (AI).

The research in the area of Neuroinformatics has been developed at IPPT PAN based on intensive international cooperation. The first works were carried out as part of bilateral Polish-Spanish projects**. The research concerned the analysis of information processing and transmission** in the cerebral cortex using Information Theory methods (**complexity, entropy**, visual signal **transmission rate**). The results of the work (theory, experiment, simulations) were published in a number of leading journals (including those published by MIT), mostly with the AI profile. The next phase of research in this field, also in international cooperation (USA, Spain), fits, among others, in the subject of a multi-million project with EU prof. H. Markram's Blue Brain Project on Virtual Brain Development. The complementary approach allowed for the achievement of a number of significant results concerning the impact on the

transmission efficiency of factors such as network architecture, role and characteristic parameters of neurons **(to design artificial brain and computers of next generation)**. The results were also published in reputable international journals. They are also **developed using the methods of Information Theory and AI to design effective classifiers of practical importance in the diagnostics** of biomedical signals. The method of analyzing ECG signals was called upon to classify patients with breathing-related sleep disorders at an early stage. In the area of biomedical signals analysis, telemetry solutions and the use of virtual and augmented reality as support for doctors, the Institute cooperates with Dr. Peter van Damen (PEACS BV, Netherlands) and the Team of Dr. K. Proniewska from the Jagiellonian University Medical College.

III. Description of the results related to the application of artificial intelligence in the context of vision systems and mobile robots

a) In the framework of BRIdge Alfa commercialisation (NCBiR), a system was designed and implemented for video processing from nonstationary camera for: detection and classification of vehicles, automatic identification of their movement parameters, determination of the intensities and stability in time for specific vehicle classes. Image stabilization and background recognition algorithms were used, as well as artificial neural networks for vehicle detection and classification. The ultimate aim was to develop a tool for online visual analysis of traffic-related toxicity. **b)** Comprehensive realization of a B+R task within the project "Development of an autonomously moving prototype platform for production environments", where a group of autonomous cleaning platforms coordinates their tasks for effective cleaning of warehouses. By using available LIDAR and RGBD sensors, a system was developed for mapping, localization, optimum path planning and following for cleaning robots. **c)** A new approach for the measurement uncertainty problem in mobile robotics was developed by replacing the typical probabilistic approach by multivalued logic and respective reasoning mechanisms. **d)** CPU and GPGPU algorithms were developed for spatial optimization of extremely modular systems. A number of non-classical optimization algorithms were adapted and used to determine the topology optimization of a light deployable bridge and for transformation planning for a modular manipulator. **New methods for structural control were developed based on artificial neural networks and reinforcement learning**.

IV. Description of results related to diagnostics and biomedical therapy. Application of AI to image processing and recognition with the use of ultrasonic data.

At IPPT PAN, work related to the application of machine learning in the analysis of medical data, especially ultrasound, is carried out by the Department of Ultrasounds (ZU) and the Professional Electronics Laboratory (LEP). **The conducted works concern the development of deep neural networks in the context of detection, segmentation and classification of human tissue pathology, as well as methods improving the quality of ultrasound images.** The cooperation of ZU with the Medical University of Warsaw and the Warsaw Cancer Center has resulted in the creation of a number of unique sets of ultrasound data. The collected data, including raw ultrasound signals (before image reconstruction), were used, among others, to develop effective **deep learning models** for segmentation and **classification of breast cancer, characterization of fatty liver disease, and monitoring the effects of chemotherapy in breast cancer.** In cooperation with ZU and LEP, neural networks are also successfully developed to improve the quality of ultrasound images. Most of the topics related to neural networks and ultrasonic imaging at IPPT PAN are also conducted in close cooperation with foreign research centers. The deep learning methods developed have been published in leading medical image analysis journals. (Ext. publication list: http://www.ippt.pan.pl/wniosek/IPPT_PAN_Wniosek_ARTIQ/)

1. Marszałek M., Burczyński T., Ordered fuzzy random variable: definition and the concept of normality, INFORMATION SCIENCES, pp.1-12, 2020.

2. Pręgowska A., Kaplan E., Szczepański J., How far can neural correlations reduce uncertainty? Comparison of information transmission rates for Markov and Bernoulli processes, INTERNATIONAL JOURNAL OF NEURAL SYSTEMS, Vol.29, No.8, 2019
3. Chikahiro Y., Ario I., Pawłowski P., Graczykowski C., Holnicki-Szulc J., Optimization of reinforcement layout of scissor-type bridge using differential evolution algorithm, COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENG. 34(6), pp.523-538, 2019.
4. Byra M., Jarosik P., Szubert A, Galperine, Ojeda-Fournier H , Olson L, Comstock Ch, Andre M., Breast mass segmentation in ultrasound with selective kernel U-Net convolutional neural network, BIOMED. SIG. PROC. CONT., V.61, pp.102027-1-10, 2020

2. A list of 5 research and development projects within national and international competitions in the area of artificial intelligence and implemented within the last 5 years prior to or in the year of the application (title, manager, source of financing, amount of financing).

[1] Intelligent design of 2D nanostructures based on molybdenum. Head: prof. Tadeusz Burczyński, NCN OPUS project, 2016/21/B/ST8/02450, value PLN 600 600, 2017-2022.
[2] The service of research and development works on the development of a multi-agent system architecture to control a group of autonomous cleaning robots as part of the project "Development of a prototype of an autonomous platform moving in a production environment", Manager: dr. Jacek Szklarski, NCBiR. Total project value: PLN 3.8 million, IPPT service value: PLN 344 736, 2020 - 2021.
[3] Advanced methods of modeling and optimization of mechanical structures of metamaterials for intelligent vibration control, Head: dr hab. Bartłomiej Dyniewicz, SONATA-BIS, National Science Center 2018-2023, value: PLN 1 072 700.
[4] Quantitative analysis of ultrasound dispersed in the tissue. Application to evaluate tumor response to chemotherapy in patients with breast cancer. Head: prof. Jerzy Litniewski, OPUS NCN 2020 - 2023, Value: PLN 673 200.
[5] FIRST TEAM project: "Decoding biochemical signaling to design more effective therapeutic strategies", First TEAM 2017-3 / 22, Head: dr hab. Michał Komorowski, source of funding: Foundation for Polish Science (FNP), 2018-2021, amount of funding: PLN 2,000,000.

Other AI-related projects carried out at IPPT PAN

I. Projects related to the use of algorithms based on evolutionary and genetic AI, artificial immune systems, swarming algorithms and artificial neural networks to the issues of optimal design of shapes, topology and material of technical systems

[1] Multiscale modeling and intelligent design of materials and structures, Head: prof. Tadeusz Burczyński, 2014/15 / B / ST8 / 04339, OPUS NCN 2014-2017

II. Neuroinformatics and Bioinformatics projects using Information Theory and AI

[1] Application of computer methods based on information theory to analyze the effectiveness of signal transmission in neural networks, Head: prof. dr hab. Janusz Szczepański, N N519 6465 40.
[2] Information-Theoretical and cryptographical aspects of neuronal discharges ”17/2004/2005, joint project with Institute of Neuroscience, CSIC - Universidad Miguel Hernandez, Head: prof. dr hab. Janusz Szczepański
[3] Computational properties of cortical neurons: analysis of neural discharges complexity in the visual system ”4043 / R01 / R02, joint project with Institute of Neuroscience, CSIC - Universidad Miguel Hernandez, Spain, Head: prof. dr hab. Janusz Szczepański

[4] European Molecular Biology Organization (EMBO) Project, Installation Grant of Dr. Michał Komorowski, entitled: "Innate immune signaling: optimal experimental protocols for microfluidic devices", Head: Dr. Michał Komorowski, funding source: European Molecular Biology Organization (EMBO) , the amount of co-financing: PLN 600,000.00
[5] Project Lider XI entitled: "Holographic Medical Assistant", head: dr. Eng. Klaudia Proniewska from the Jagiellonian University Collegium Medicum, source of funding: National Center for Research and Development (NCBiR), main contractor: Dr. Agnieszka Pręgowska, amount of funding: PLN 1,498,025.00

III. Artificial intelligence projects, with particular emphasis on vision systems and mobile robots

[1] Adaptive aerostats, stretched on the SDT (Self-Deployable Tensegrity) support structure, as a platform for multi-thematic monitoring of the Earth's surface (Aero-SDT), Head: Jan Holnicki-Szulc, NCBiR, value: PLN 1,441,250
[2] Modeling of agent cooperation with the use of multi-valued logic and parallel information processing, Head: Adam Borkowski, National Science Center, value: PLN 626,200. Implementation 2013-2016
[3] Arm-Z: extremely modular hyperredundant economic manipulator - development of control methods and efficiency analysis, Head: dr hab. Maciej Zawidzki, National Science Center, 2020-2023, value: PLN 752,456
[4] R&D service for the development of an expert module for a diagnostic and monitoring system designed to monitor industrial fans driven by electric motors. Head: Robert Konowrocki, PARP, value of the service for IPPT: PLN 269,691
[5] Advanced methods of mass parallelization of numerical calculations in structure dynamics, Head: Czesław Bajer, National Science Center, value: PLN 604,200
[6] Semi-active vibration damping using layered structures with an intelligent core. Head: Bartłomiej Dyniewicz, National Science Center, value PLN 693,930.
[7] Modeling and vibration control methods of structures with the use of intelligent materials. Head: Czesław Bajer, National Science Center, value: PLN 397,700.
[8] Model-based adaptive-predictive control of semi-active liquid silencers subjected to unknown shock loads, Head: Cezary Graczykowski, National Science Center, value: PLN 318,100
[9] Dynamic reconfiguration methods in structural control issues: development of new control algorithms and verification of their effectiveness, Head: Łukasz Jankowski, National Science Center, value: PLN 559,800

IV. Projects related to diagnostics and biomedical therapy. Application of AI for image processing and recognition with the use of ultrasonic data

[1] Methods for determining new ultrasound parameters of neoplastic tissue. Their physical interpretation and evaluation of their usefulness in breast cancer diagnostics. Head: prof. dr. hab. Jerzy Litniewski. NCN OPUS, amount: PLN 234,200.
[2] Assessment of neoplastic changes on the basis of parametric discrimination of statistical properties of ultrasound dispersion in breast tissue. Head: prof. dr hab. Eng. Andrzej Nowicki, NCN OPUS, amount: PLN 807,672.

3. Available research equipment, apparatus/infrastructure and intangible assets held in the context regarding artificial intelligence.

I. IT infrastructure of IPPT PAN enabling the implementation of complex computational costly tasks

The IT infrastructure of the IPPT PAN is adapted to high-power computing, which is very important when calculating the use of artificial intelligence methods. The IPPT LAN network implemented as a Gigabit Ethernet network **includes a cluster computing system** and about 300 PCs of LAN users. The GRAPHEN multi-processor cluster system operates at IPPT PAN, purchased under two POIG projects implemented here. This system consists of components that provide computing and virtualization services. **The computational part allows for the implementation of large computational tasks based on parallel calculations and access to databases.** This enables a **significant acceleration of computational tasks**, data search for statistical and IT analyzes or the preparation of visualization of large collections. The computing system is supplemented with a node with GPU cards (Nvidia Tesla) enabling the execution of calculations on graphics processors. Virtualization servers allow to use the installed application software and are also used to host multiple WEB services. The launched cluster system obtained the total computing power measured parametrically as the number of floating point operations of the order of 12 TFLOPS.

The cluster system also includes other elements necessary for its functioning, such as:

- Hitachi HDS AMS 2500 disk array equipped with SAS / SATA disks with a total capacity of 68 TB,
- 2 access servers for cluster queue management (master HPC), on which a virtual machine supporting logging into the cluster is installed and the software managing the running of tasks (464 physical cores and 1222 GB of RAM memory).
- 2 service servers for the integration of the HDS AMS 2500 disk array with the computing environment, supporting the LUSTER file system, where user data is stored. The cluster system, placed in a server room specially built for this purpose, was designed so that it could be expanded. The cluster system is connected to the LAN via the Gigabit **Ethernet network with the possibility of increasing this speed** and has a fiber optic connection with a speed of 10 Gb / s with other Biocentrum Ochota institutes.

II. Equipment for the implementation of projects in the field of artificial intelligence - vision systems and mobile robots

IPPT PAN has a wide range of tools for the implementation of projects in the field of artificial intelligence, with particular emphasis on vision systems and mobile robots. Computing units are available: minicomputers for mobile applications (Raspberry Pi, Up Board, Jetson Nano, Jetson Xavier); strong workstations equipped with the latest GPU cards; Graphene computing cluster (CPU + GPU) for solving large optimization problems.

In addition, the Institute has many sensors: a wide range of mini cameras (MIPI CSI, USB) with various lenses; sensors IMU, GPS, LIDARs, dedicated cameras for tracking (Intel T265 type), cameras with RGBD depth map (eg Intel D435), batteries and extensive workshop facilities, electronic and 3D printers, including one large-size. In addition, we have a universal platform - the Romeg2 mobile robot - which can move (on wheels) inside and outside buildings. A workshop equipped in such a way can be used to create the latest prototypes of devices in the field of machine vision or mobile robotics.

The Institute also has a number of test stands for testing the actual effectiveness of algorithms in the context of monitoring and control of mechanical structures, equipped with LabView CompactRIO with FPGA processor for data acquisition, real-time processing and control, LMS data acquisition systems, and MTS actuator system.

III. Apparatus for image processing and recognition using ultrasonic data. Simulation and training of neural networks

IPPT PAN has access to unique research equipment - including:

- Medical ultrasound machines (Siemens Antares, Zonare, Ultrasonix Sonix-Touch).
- Research ultrasonic platforms: o USPlatform - own development, raw ultrasonic data acquisition system with integrated GPU; o us4R-lite, us4R - modern systems for the acquisition and processing of raw ultrasonic data by us4us, which allow the implementation of any ultrasound modalities;
- Verasonics Vantage ultrasound system with 2D and 3D probes.
- NVIDIA DevBox - dedicated GPU cluster for simulating and training neural networks.
- GRAFEN Cluster - dedicated HPC infrastructure to perform simulations and calculations.
- Workstation equipped with NVIDIA Titan RTX graphics card for training deep neural networks. In addition, a number of desktops with other cards, such as NVIDIA RTX 2080 Ti.

4. Facilities or incentives to establish an AI Centre of Excellence in IPPT PAN.

Research in many areas is conducted at IPPT PAN. It is in fact a multidisciplinary and interdisciplinary institute, which enables the application of AI methods comprehensively in many areas. **Research conducted in this way can produce a strong synergy effect.** The confirmation of multidisciplinarity is the fact that the Institute has highly qualified staff and is authorized to award scientific degrees in the following 5 disciplines: Materials Science, Mechanical Engineering, Informatics and Telecommunications, Biomedical Engineering, Automation, Electronics and Electrical Engineering.

The results of IPPT PAN so far (confirmed, among others, by the award of the highest category in Poland, A+), and the dynamics of the Institute's activities, are a guarantee of successes in developing topics related to the use of Artificial Intelligence in many areas, both in terms of theoretical and application.

Intensive international cooperation with many leading institutions in the world is conducted at IPPT PAN.
In addition to experienced researchers, IPPT PAN also has a dynamically active junior staff. Particularly noteworthy in this context is the implementation at IPPT PAN as many as three prestigious grants awarded by the FNP, namely FIRST TEAM. This is a unique situation in Poland.
It is worth noting that the Institute currently employs as many as **8 winners of the Minister of Science award** for **outstanding young scientists**.

IPPT PAN is the coordinator of the **Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences (SD TIB PAN)**, which includes the System Research Institute of the Polish Academy of Sciences, the Institute of Biocybernetics and Biomedical Engineering M. Nałęcza PAN, Institute of Theoretical and Applied Informatics of the Polish Academy of Sciences, Institute of Experimental and Clinical Medicine M. Mossakowskiego PAN, the Institute of Computer Science of the Polish Academy of Sciences and the Institute of Fundamental Technological Research of the Polish Academy of Sciences and the Scientific and Academic Computer Network - National Research Institute (NASK-PIB). SD TIB PAN conducts doctoral studies in three disciplines: Technical IT and Telecommunications, Biomedical Engineering and Medical Sciences. **One of the basic areas of TIB PAN activity is AI,** also seen in the context of biological inspiration and medical applications.

The Institute also runs the **IPPT PAN Doctoral School**, which continues the tradition of the IPPT PAN Doctoral Studium established in 1968. In the years 1968 - 2018, the Institute promoted approximately 750 doctors and approximately 245 habilitated doctors. The school is authorized to award degrees in 5 disciplines: Materials Engineering, Mechanical Engineering, Informatics and Telecommunication, Biomedical Engineering and Automation, Electronics and Electrical Engineering.

Advanced research on application of AI methods, mainly evolutionary and memetic algorithms, to design new 2D nanomaterials based on Carbon and Molibdenum has conducted [1, 2] at the IPPT PAN. In Computational Intelligence and Engineering Team new graphene-like materials X and Y [1, 3] and new Anisotropic-Cyclicgraphene as a new 2D Semiconducting Carbon Allotrope [4] generated using AI-methods. In the Nanomaterials for Electronic and Biomedicine Applications Team various kinds of graphene are produced and research on its applications to material science, electronics and medicine is conducted.

1. Mrozek A., Kuś W., Burczyński T., *Nano level optimization of graphene allotropes by means of a hybrid parallel evolutionary algorithm*, COMPUTATIONAL MATERIALS SCIENCE, Vol.106, pp.161-169, 2015.
2. Kuś W., Mrozek A.,, Burczyński T., *Memetic optimization of graphene-like materials on Intel PHI Coprocessor*, LECTURE NOTES IN ARTIFICIAL INTELLIGENCE, Vol.9692, pp.401-410, 2016.
3. Maździarz M., Mrozek A.♦, Kuś W.♦, Burczyński T., *First-principles study of new X-graphene and Y-graphene polymorphs generated by the two stage strategy*, MATERIALS CHEMISTRY AND PHYSICS, Vol.202, pp.7-14, 2017.
4. Maździarz M., Mrozek A.♦, Kuś W.♦, Burczyński T., *Anisotropic-Cyclicgraphene: A New Two-Dimensional Semiconducting Carbon Allotrope*, MATERIALS, Vol.11, No.3, pp.432, 201

5. Other information concerning internationalisation of IPPT, foreign scientists employed in this institution, availability of seminars in English.

IPPT PAN conducts a very intensive and advanced cooperation with foreign institutions in many areas that are of interest to many renowned world institutions, in particular in the field of application of Artificial Intelligence. The areas of cooperation are Materials Engineering, Technical Informatics, Mechanical Engineering, Biomedical Engineering. A clear confirmation of this is the fact that in 2020 the authors from the IPPT PAN published joint articles with foreign co-authors in prestigious journals from the JCR list (score above 70 points from the list of the Ministry of Science and Higher Education) **from 40 countries, including: USA (22 publications, 43 authors), Italy (17 publications, 29 authors), China (15 publications, 27 authors), UK (12 publications, 14 authors), France (10 publications, 20 authors), Germany (7 publications, 10 authors), Japan (4 publications, 8 authors)** and a number of other countries from almost all continents.

Among the institutions cooperating with IPPT PAN (confirmed by joint publications) are such excellent institutions as: **Princeton University USA, University of California San Diego USA**, Icahn Mount Sinai School of Medicine New York USA, **CNRS France**, **University of Cambridge UK**, University of Padua Italy , University of Illinois USA, Swiss Federal Laboratories for Materials Science and Technology Switzerland, **University of Oxford UK**, **Technion – Israel Institute of Technology Israel**, University Mainz Germany, **Harvard University USA**, **Imperial College London UK**, South China Normal University China, Guangzhou Design Institute China, University of Maryland USA, Yale University USA, **Hiroshima University Japan**, Western Washington University USA and a number of other recognized institutions.

The Institute is implementing a project financed (PLN 2 million) by the NAWA Foundation entitled "International collaboration on complex systems and modern technologies" ITHACA (2018-2021). As part of the **IPPT PAN** project, **it cooperates with 13 foreign partners, including 7 from the European Union and non-EU countries from 3 continents, including the USA and New Zealand.** There is an intensive scientific exchange, joint seminars and conferences / workshops, joint publications appear.

A very important role in the development of scientific thought is played by seminars (conducted in English), in particular the multi-disciplinary Monday seminar conducted in English for several dozen years. Last year, the speakers included such outstanding scientists (in brackets the Hirsch index and the number of citations according to Google Scholar) as: Prof. **Davide Bigoni** (H = 40, 5553) University of Trento, Italy, ERC competition winner; Prof. **James A. Glazier** (H = 59, 12260) Biocomplexity Institute and Department of Intelligent Systems Engineering, Indiana University, Bloomington, USA; Prof. **Mark Chaplain** (H = 65, 15684); University of St. Andrews, United Kingdom; Prof. **Philip Maini** (**H = 84, 254480**) Mathematical Institute of University of Oxford, United Kingdom; Prof. **Mark Alber** (H = 45, 5643) Department of Mathematics, Center for Quantitative Modeling in Biology, University of California Riverside, USA; Prof. **Mostafa Adimy** (H = 26, 2051) French Institute for Research in Computer Science and Automation (INRIA) and University Lyon 1, Lyon, France; Prof. **Stuart A. Newman** (H = 57, 9569) New York Medical College, USA; Prof. **Vitaly Volpert** (H = 41, 7478) University Lyon 1, Lyon, France.

Thanks to open internationally competitions, the internationalization of the Institute is increasing. Currently, the Institute employs 11 foreign scientists out of a total of 163 employees participating in scientific research.

In doctoral schools run by IPPT PAN, the following students are studying:

- at the IPPT PAN Doctoral School 9 foreigners out of a total of 18 doctoral students (**50%**),
- at the TIB PAN Doctoral School 11 foreigners out of a total of 25 doctoral students (**44%**).

It is worth emphasizing the cooperation with an **outstanding specialist in the field of AI, prof. Witold Pedrycz**, Department of Electrical and Computer Engineering, University of Alberta, Edmonton T6G 2R3, Canada, who is the Editor-in-Chief of the journal *Information Sciences*, Elsevier, one of the best IT journals in the world (200 points on the ministerial list) and the Journal of *Smart Environments and Green Computing*, https://segcjournal.com/,
whose **Deputy Editor is prof. T. Burczyński** [https://segcjournal.com/editorsChief/index].

6. Other significant information confirming the experience and resources of IPPT.

The Institute was established in 1953, and **the history and tradition of the Institute** are the basis of the present day. Purpose oriented research projects, high efficiency and openness to new ideas are always highly appreciated. **Cooperation with industry, joint programs with leading research centers in the country and abroad**, and participation in higher education programs are the main directions of the current activity, in which basic research is supported and combined with applications.

In recent years, the apparatus at the Institute has been significantly modernized. Experimental research [related to Material Engineering (new materials with unique properties, but also research related to Biomedical Engineering and single biological cells (cancer issues and analysis of immune systems)] are carried out in modernized laboratories based on world-class equipment.

In the last few appraisal procedures (named Evaluations), conducted every 4 years, the scientific achievements and achievements of institutes and universities in Poland, **the Ministry of Science awarded the IPPT PAN with the highest possible category, i.e. the A + category. Recently, only about 50 out of about 1,000 institutes and universities have been granted by this high category.** The Institute is currently one of the largest research institutions within the structure of the Polish Academy of Sciences.

Highly qualified research staff is an important advantage of the Institute. At IPPT PAN, 163 employees are involved in scientific research, including:

- 26 full professors,
- 35 habilitated doctors,
- 89 doctors.

The Institute currently employs **5 members of the Polish Academy of Sciences** (3 Ordinary Members and 2 Corresponding Members) and 1 Foreign Member of the Polish Academy of Sciences.

The Scientific Council of the IPPT PAN supervises the evaluation and implementation of research at the Institute as well as setting new directions. It is worth noting that the IPPT PAN Scientific Council includes **8 Ordinary Members of the Polish Academy of Sciences** and **5 Corresponding Members of the Polish Academy of Sciences**.

In the context of continuing (experience) and developing research related to Artificial Intelligence, it is worth emphasizing the achievements of Prof. T. Burczyński who played the role of Guest editor in the Special Issues devoted to AI (Elsevier):

1. Burczynski, T., Cholewa W., Moczulski, W. (Guest editors), Journal of Engineering Applications of Artificial Intelligence. Special Issue on Selected Problems of Knowledge Representation. Vol.17, No. 4, 2004, Elsevier.
2. Burczyński T., Cholewa W., Moczulski W., (Guest editors), Engineering Applications of Artificial Intelligence: Special Issue on Soft Computing Applications, Vol. 20, No. 5, 2007, Elsevier.
3. Burczyński, T., (Guest Editor), Information Science Journal. Special Issue on Artificial Immune Systems, Vol. 179, Issue 10, 2009, Elsevier.

A more complete list of information about IPPT PAN research (publications) in the field of Artificial Intelligence can be found at link:
http://www.ippt.pan.pl/wniosek/IPPT_PAN_Wniosek_ARTIQ/ . Full information about IPPT PAN is available on the Institute's website: https://www.ippt.pan.pl/