Industrial Fellowships Program 2017

DEMOKRITOS
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH

Industrial Fellowships Program 2017

Made possible by a grant from the Stavros Niarchos Foundation

DEMOKRITOS
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH

Investing in new knowledge and technology Creating growth and employment in Greece

PREFACE

The National Centre for Scientific Research "Demokritos" proudly introduces the Industrial Research Fellowship Program, made possible by a generous Grant from the Stavros Niarchos Foundation. The Program aimed towards talented Researchers with a strong interest for applied, Industrial Research.

The Fellows for 2017 have been selected after a peer-reviewed process by a network of Experts from Universities and Research Centers from all over Greece. The evaluation criteria were focused on the excellence of their Academic Profiles, the scientific merit of their proposals and the degree of commitment and involvement of the supporting Companies in the proposed research.

The Board of Directors of "Demokritos" congratulates each and every one of the 2017 Fellows for their success and for becoming part of a pivotal Program that will strengthen the bonds between the Centre and the participating Enterprises.
We congratulate the participating Companies and sincerely thank them for their contribution to the Fellowship fund and for trusting the Centre as a partner for this and future endeavors. We congratulate the Researchers of the Centre that will for the next years become mentors of innovative work. Finally, we express our gratitude to the Stavros Niarchos Foundation for believing that Demokritos can produce high-impact industrial research in collaboration with some of the most dynamic Greek companies and for making the entire Program possible.

"We wish to all the involved parties success and fruitful discoveries".

On behalf of the Board of Directors
Georgios Nounesis, Chairman

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Ceramics and Composite Materials (CCM)

Scientific Mentor:
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AMENTA MARIA

Development and evaluation of self-healing cement composites by incorporation of encapsulated inorganic admixtures and hydraulic phases

The main objectives of this project include the development and evaluation of a group of self-healing cement composites that will incorporate different types of encapsulated healing agents, such as activated mineral admixtures and hydraulic phases and the development and optimization of the encapsulation methodology, including solid dispersion parameters for effective self-healing cement and concrete mixtures, such as mechanical properties of the produced microcapsules, rheological properties of wet mixtures, microstructural and mechanical properties of hardened mixtures.
In order to achieve these objectives, a knowledge-based repository on laboratory-generated data (experimental) and theoretical results for currently available and future emerging self-healing technologies will be generated. The repository will provide TITAN a valuable tool for enabling in prompt time the most promising technological and material solutions, for enhancing the service life of cement and concrete mixtures. The main scientific areas, where data will be generated, encompass various types of healing agents, encapsulation methodologies and parametric optimization of self-healing cement and concrete composites.

Company Mentor: Dr. MARIOS KATSIOTIS | **www.titan-cement.com**

Magnetic Nanomaterials Lab

Scientific Mentor:
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AMPOUMOGLI ASEM

Fabrication and characterization of 3D printed thermoelectric and magnetic components for smart applications

3D Printing allows for the ability to design and manufacture tools, products, prototypes etc. in a short time, accelerating the manufacturing cycle, compared to traditional manufacturing methods which entail significant labor and waste. The project's objectives will be to expand the applicability of Fused Deposition Modeling type (FDM-3DP) technology and dispenser 3DP (using inks), which are the most common forms of additive manufacturing, to the magnetic and thermoelectric materials of technological interest for the hosting company AMEN. Specifically, the project will investigate the feasibility of producing bonded magnetic components using FDM-appropriate thermoplastic-based filaments as well as thermoelectric generator components using dispenser-appropriate ink based printing.

Company Mentor: Dr. ALEXANDRA IOANNIDOU | **www.amen-technologies.com**

Membranes & Materials for Environmental Separations Laboratory

Scientific Mentor:
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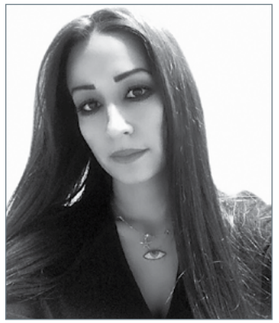
ANGELOPOULOS EVANGELOS

Design and development of a low cost sensor for qualitative and quantitative assessment of diesel fuel

We envisage the development of a new class of sensor that will be used in the fixed and mobile asset management industry and will provide simultaneous qualitatively and quantitatively assessment of diesel fuel in real-time. The ultimate goal of this 4 years project is to develop an innovative, low-cost small form sensor that will be easily integrated with third party Internet of Things (IoT) automotive platforms, therefore substituting the need for expensive off-site fuel characterization that is the current norm. The objective is to unravel the basis of accurate diesel fuel quality measurement, decipher the determinants of fuel quality properties, study the majority of existing laboratory fuel analysis methods and invent a new type of industrial diesel fuel sensor.

SNV ENGINEERING

Company Mentor: Dr. DIONYSIS SKAMNAKIS | **www.snveng.gr**



Immunoassays & Immunosensors Lab

Scientific Mentor:
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ANGELOPOULOU MICHAILIA

Development of methods for rapid simultaneous detection of multiple bacteria species in milk and juices through Mach-Zehnder Interferometers array monolithically integrated on silicon chips (BACTOTRAP) integrated on silicon chips (BACTOTRAP)

The proposal aims at the fast detection of three pathogens, namely Salmonella spp, Escherichia coli, and Bacillus cereus in milk, and one spoilage bacteria (Alicyclobacillus acidoterrestris) in juice samples using Mach-Zehnder interferometer (MZI) arrays integrated on silicon chips. Currently, the detection of these bacteria is performed through multi-step and time-consuming procedures (at least four days). The project will target the simultaneous immunochemical detection of these bacteria at very low concentrations after a few hours enrichment through functionalization of individual MZIs of a single chip with bacteria-specific antibodies. Furthermore, especially for Alicyclobacillus acidoterrestris, for which there are not commercially available antibodies, a rabbit polyclonal antibody will be developed and evaluated for its immunochemical determination. In addition, through improvements in sensor and fluidic design, stabilization of the immobilized onto MZIs immunoreagents and implementation of different signal enhancement approaches high detection sensitivity and suppression of the analysis time will be pursuit.

DEATA

Company Mentor: Dr. DIMITRIS GHIKAS | **www.vivartia.com**

Integrated Systems Laboratory

Scientific Supervisor:
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BAMPATSIKOS MICHAIL

Management of Healthcare Data and Intellectual Property in Participatory Creativity using Blockchains

In recent years the use of blockchain technology, which is the backbone of the bitcoin Network, has been considered in a wide variety of applications.
This research will examine how the blockchain technology can be used to implement a decentralized electronic healthcare record and to determine what security and privacy factors must be considered during the design phase of such a system. Additionally, the possibility to use blockchain technology to secure Intellectual Property Rights in participatory creativity/design will be explored. In this case a system will be developed that will enable all entities that participated on the creation of a digital asset to receive royalties every time that asset is used. Furthermore, the asset's creators must have control over how, where and by whom their work is used.

EXODUS

Company Mentor: Dr. DIMITRIOS VASSILIADIS | **www.exodussa.gr**

Laboratory of Nanofunctional and Nanocomposite Materials

Scientific Mentor:
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BARDI NIKI

Graphene Based Nanocomposite Electrodes for High Energy Density Supercapacitors

New composite material formulations based on graphene are to be investigated; such as electrodes of high energy density. Electrolytic Double layer Capacitors (EDLCs) are commercially known as supercapacitors. Supercapacitor is finding its place across many industry verticals; such as consumer electronics, transportation and industrial segments, due to its advanced features, like high power pulse, extended life and steadily lower cost for consumers. Nevertheless, practical capacitive behavior of pure graphene is lower than the anticipated value; mainly due to the serious agglomeration during both the preparation and application processes. Therefore, boosting the overall electrochemical performance of graphene-based materials still remains a great challenge. The main objectives of the project are the development of novel electrodes based on graphene-based composites in different structures; like one-dimensional (1D) fibers, two-dimensional (2D) thin films and three-dimensional (3D) foams with good performance characteristics and clear reproducibility and the establishment of a scalable electrode production process where all the parameters are optimized and clearly defined in order to achieve constant quality and performance of the produced material towards subsequent successful commercialization steps.

PLEIONE ENERGY re-think energy!

Company Mentor: Dr. ANTONIOS VAVOULIOTIS | **www.pleione-energy.com**

Energy Harvesting and Autonomous Sensors Group

Scientific Supervisor:
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BARMPAKOS DIMITRIOS

A multi parametric measurement and control system implemented on flexible substrates with printing technologies

This project is targeting on the development of a system on flexible substrate by utilizing inkjet printing, screen printing and mixed design procedures. Sensing of parameters such as humidity, leakages, temperature, pressure and gas - liquid flow on challenging spots of interest such as pipelines that rigid electronics cannot be installed onto, will drastically improve the monitoring resolution of machines' operating circles that depend on such parameters. The proposed system will provide data to the machines' actuators, insights to the user and profiles directly back to R&D in order to further optimize efficiency both on operating and on design – engineering level. Major tasks of this project include experimental evaluation of substrates, printable materials and sintering techniques, modes and methods of sensing, implementation of readout electronics to provide compatibility with existing interfaces and study of packaging – installation.

HELIIX Reinventing Energy

Company Mentor: NICK ARAPKOULES | **http://heliixinc.com**

Membranes and Materials for Environmental Separations Laboratory

Scientific Supervisor:
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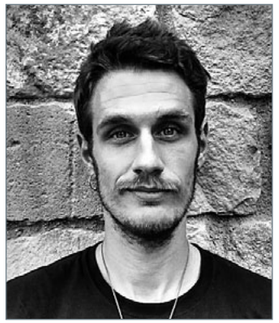
BOUKIS FILIPPOS

Compact membrane reactor combined with novel membrane in intensification systems to produce low-cost hydrogen from biogas

This project is aiming to the production of decentralized bio-hydrogen from the conversion of biogas. This will be achieved with the use of a novel Pd or Ni ceramic separation membranes using the method of Chemical Vapor Deposition. At the same time, a novel Au nanoparticle /ionic liquid catalytic membrane unit will be used to reduce the CO concentration (that occurred for the previous procedure) down to 20 ppm. The final goal of the project is the implementation of an industrial unit based on those principles in order to achieve better environmental and financial efficiency of hydrogen production, comparing to the methods that are currently established.

ELLAKTOR

Company Mentor: Dr. IOANNIS BOUKIS | **www.helector.gr**



Epitaxy and Surface Science Laboratory (ESSL)

Scientific Supervisor:
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CHAITOGLOU STEFANOS

Graphene/CNT hybrid composites as electrodes for supercapacitor applications

The objective of the project is the preparation of high performance supercapacitor (SCs) devices. Supercapacitors are composites characterised by their high power density, high charge/discharge rates, and long cycle life performance. Target of the present project is the preparation of electrodes based on graphene/ carbon nanotubes based hybrid materials. Graphene and carbon nanotubes (CNTs) are materials that exhibit excellent electrical conductivity and large specific surface areas, making them ideal for these kind of applications. We propose the preparation of such electrodes using chemical vapor deposition (CVD) technique for the growth of both the graphene and carbon nanotubes. Key factor of the proposal is to use the graphene as a substrate for the CNTs growth, to study the covalent bonding between carbon nanotubes (CNTs) and graphene and the use of a floating buffer layer. The graphene-CNTs bonding will permit to obtain a 3-dimensional hybrid material which stands over a metallic substrate, a fact that normally CNTs alone are repelled to complete. The buffer layer assists the growth of aligned, single wall CNTs, deterring the reduction of the graphene film quality. After the optimization of the electrode preparation, we will study its electrochemical characteristics through the fabrication of the SCs device. In addition, we want to study how the post growth deposition of metal oxide (MeO) particles or films can attribute to the capacitance of the hybrid materials. MeO structures can provide high pseudocapacitance due to faradic redox reactions taking place on large surface area electrodes.

Company Mentor: Dr. STEFANOS NITODAS | **www.glonatech.com**

Nanotechnology processes for solar energy conversion and environmental protection Lab

Scientific Supervisor:
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CHIOTI AFRODITI

Development of an alternative method for the reduction of microbial load in Anaerobic Digestion systems based on photocatalysis

Anaerobic digestion is one way of treating biowaste and producing energy in the form of methane (biogas). Afterwards, the digested residue may be used as fertilizer on agricultural land. However, anaerobic digestion is not enough to eliminate the danger of pathogen contamination and current pre-treatment sanitation methods are either ineffective or expensive. Therefore, an efficient, repeatable, low cost and low energy consumption methodology is essential in order to eliminate the potential risk of environmental pollution and infection in humans. Among the alternative processes currently being developed, photocatalysis has emerged as a very attractive and environment friendly technology for wastewater disinfection, especially as solar light can be used to drive the process. To the best of our knowledge, a photocatalytic process for the reduction of microbial load of livestock waste (e.g., manure) has not been described in any studies so far. Thus, the main objective of our proposal is to further investigate photocatalysis in separated liquor digestate of biogas plants.

Company Mentor: THEMISTOKLIS SFETSAS | **www.q-lab.gr**

Membranes and Materials for Environmental Separations Laboratory

Scientific Supervisor:
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CHOLEVA EVANGELIA

Nanostructured adsorbents and membranes for biogas refining and upgrade via H_2S capture and CO_2/CH_4 separation processes

The main goal of this project is the development of a new innovative and economically feasible process for the upgrading of the biogas to biomethane grade fuel through the removal of its two main pollutants, H_2S, CO_2 and CH_4. The approach that is proposed as the alternative to the prevailing upgrade methods comprise an adsorption step for the H_2S removal followed by a membrane stage for the enriched (in methane) of the desulfurized biogas combined with the developed of new functionalized carbon nanomaterials (H_2S adsorption) - able to achieve sorption capacity values higher than 8.0 mmol H2S/g sorbent - as well as the fabrication of hybrid NF/IL membranes (CO_2/CH_4 separation) with 6:1 selectivity and 3500 Barrer permeability in CO_2 at relative low pressures (5-10 bars).

Company Mentor: THEMISTOKLIS SFETSAS | **www.q-lab.gr**

Catalytic-Photocatalytic Processes and Environmental Analysis Laboratory

Scientific Mentor:
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CHRISTOPHORIDIS CHRISTOPHOROS

From source to tap: risk assessment of organic pollutants in the drinking water cycle of Athens

The objectives of this project are (a) to provide adequate information on the presence and potential formation of selected emerging pollutants and their transformation products throughout the water supply system of EYDAP S.A. (water sources, treatment, distribution network) using state-of-the art analytical instrumentation and fully validated analytical methodologies, (b) to develop a fast and reliable analytical workflow able to simultaneously detect the presence of multiple water quality threats at the water source, using high resolution mass spectrometry, (c) to elucidate the degradation pathways and produced transformation products of selected emerging pollutants in drinking water using advanced oxidation processes (e.g. photocatalysis, sonolysis), (d) to provide a useful dataset of water quality data and register the main risks and hazards in the water supply system. Through this project, the largest drinking water company of Greece, and one of the largest in Europe, will acquire the knowledge and the technical guidance to identify the potential threats to water quality throughout the whole drinking water cycle (source, treatment, distribution network), in order to develop a risk assessment system, to start implementing a Water Safety Plan (WSP) and to become a key opinion leader in anticipation to the forthcoming EU regulations in the field.

Company Mentor: Dr. TRIANTAFYLLOS KALOUDIS | **www.eydap.gr**

Software and Knowledge Engineering Laboratory

Scientific Supervisor:
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DAVVETAS ATHANASIOS

Combination of diverse types of data for analytics in insurance and legal contexts

This project aims to create models for combining diverse data sources for data analysis suited to insurance and legal challenges. It will lead to the prototyping of novel solutions targeting insurance and legal experts, allowing them to make informed decisions by taking advantage of a multitude of open and proprietary data. Such data will include news feeds, social media, insurance sources and photographic evidence, as well as weather and other environmental data. The prototype models will lead to the improved enforcement of insurance policies and aiding the risk assessment in case of sea incidents. The data products extracted by combining diverse data sources are expected to lead to the establishment of a test bed capable of providing experience to field experts in damage control using different scenarios (hypothetical or real), as well as to enable high-quality quantitative evaluation of the proposed methods and algorithms.

Company Mentor: TAKIS VARELAS | **http://web2.danaos.gr**

Plasma Nanotechnology Lab

Scientific Mentor:
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ELLINAS KOSMAS

Optimizing razor blades using plasma processing

One of the most important factors influencing the shaving quality is the hydrophobic coating on the razor blade. Most companies use a polytetrafluoroethylene (PTFE) liquid coating of low molecular weight deposited by spraying an aqueous dispersion of PTFE nanoparticles, and subsequent sintering to obtain a thin film. The thickness, topography, mechanical and wetting properties of the coating are extremely important for the shaving quality. The purpose of this proposal is to develop, in collaboration with BicViolex SA, new processes, materials and characterization methods to improve the properties of such coatings.

Company Mentor: Dr. KOSTAS MAVROIDIS | **http://gr.bicworld.com**

Membranes and Materials for Environmental Separations Laboratory

Scientific Mentor:
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ENOTIADIS APOSTOLOS

Advanced Multifunctional Coatings for outdoor Applications

The ultimate goal of this project is the development of new, efficient multifunctional coatings systems for large areas coverage, possessing a rare combination of mechanical durability, weather stability and hydrophobic/self-cleaning/anti-icing properties. Within the project the modification will be pursued through the incorporation of specially developed nanoadditives, mainly based on silica. Special attention will be given to the structural characteristics of silica nanoparticles and their surface functionalization, attaching appropriate functional groups that will impart poor water wetting to the final coating.
The advantage of using silica-based nanofillers is that they can easily lead to innovative materials with low cost, well-known surface chemistry, no toxicity, well-defined structure, mechanical robustness and UV stability.

Company Mentor: DIMITRIOS KOKKONIS | **www.berling.gr**

Environmental Radioactivity Laboratory

Scientific Mentor:
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FETFATZIS PRODROMOS

AirSensis

In this project the objective is the development of the AirSensis, an accurate, small, low cost smart sensor system having application packages, aiming to commercial product. The area of interest is the indoor air environment monitoring and control for home and work, targeting to energy savings and wellbeing. The current state of the art sensors, measure a number of parameters namely, temperature, humidity, carbon dioxide, carbon monoxide, number of airborne particles PM10, PM0.5 up to PM2.5, VOCs, etc. AirSensis, is a smart IoT device, which can interact with the owner using mobile apps or voice messages, graphics, visual effects and able to control the heating-cooling devices or air ventilation systems that utilize healthy conditions and energy efficiency. Data analysis can be used for further services or products for the provider, in this case mSensis.

Company Mentor: SARIGIANNIDIS GEORGE |**www.msensis.com**

FLOROS IOANNIS

NEXT- generation DESALlination membranes and hybrid sytems (NEXT-DESAL)

Membranes and Materials for Environmental Separations Laboratory

Scientific Mentor:
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The aim of this project (NEXT-DESAL) is to develop the "next-generation" of desalination systems by combining innovative membranes to membrane-distillation/membrane-crystallization (MD/MCr) unit with nanofiltration and/or ultrafiltration (NF/UF), which will lead to the development of a novel desalination unit exhibiting low energy consumption and minimum fouling problems. In order to implement NEXT-DESAL's goal, several optimization and development activities will be achieved.

1. Development of novel high water flux Aligned Carbon Nanotube (ACNT) Membrane Distillation (MD) membranes
2. Development of novel Mixed Matrix Membranes (MMM) forward osmosis (FO) and nanofiltration (NF) containing in the separating layer of the double-layer hollow polymeric memrbanes graphene oxide/CNT nanocomposites
3. Integration, operation and optimization of the NF/FO and MD membranes to develop a low pressure operating system with Zero or nearly zero Liquid Discharge (ZLD) a small lab-scale pilot unit with a capacity of 1 m3/day.
4. Feasibility studies, dissemination

Company Mentor: LAOUDIS KOSTAS | **www.ecotech.gr**

FOSTIRA FLORENTIA

Genetic signatures detected by Next Generation Sequencing on ovarian cancer navigate towards Precision Medicine

Molecular Diagnostics Laboratory

Scientific Mentor:
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The ultimate goal of this project is the development of a Next Generation Sequencing-based diagnostic test that will simultaneously test for mutations in BRCA1 & BRCA2 genes as well as additional Homologous Recombination (HR) genes, in both the germline and the tumor of ovarian cancer patients. This will identify optimal candidates for poly-adenosine diphosphate-ribose polymerase (PARP) inhibitors based therapy. PARP inhibitors have been approved by the European Medicines Agency as a maintenance therapy in ovarian cancer, while clinical trials are addressing their use as monotherapy, currently restricted to BRCA1 & BRCA2 mutation carriers. Patients carrying deleterious germline or somatic mutations in other HR genes will be subsequently offered the opportunity to be treated with PARP inhibitors, based on their genetic profile, with detected mutations playing the role of potential biomarkers.

Company Mentor: Dr. FOTEINI PAPAGEORGIOU | **www.astrazeneca.com**

Radiochemistry Studies Laboratory

Scientific Mentor:
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FRAGOGEORGI EIRINI

INFANT - Imaging for NanoFormulAtions & Nanopath kiT

The project aims i) to promote new preclinical imaging products for BET, ii) to provide unique joint imaging services with particular focus in nanomedicine research and iii) to develop commercial nanoparticle radiolabeling kits for NCSR D. The imaging systems will be fully characterized by using standard radiopharmaceuticals and by testing different protocols for various bio-molecules. A side benefit of the project is the speed-up of in vivo research on novel nanomaterials, by using this new generation of preclinical imaging systems, taking advantage of the company's now running or planned projects, which cover a variety of diagnostic and therapeutic applications of nanoparticles. To further facilitate the in vivo studies of novel nanoparticles a radiolabeling kit with Tc-99m for magnetic nanoparticles will be prepared as a proof-of-concept in an easy and stable way and will pave the way to various types of nanoparticles.

BET solutions BioEmissionTechnology

Company Mentor: MARIA GEORGIOU | **http://betsolutions.gr**

Institute of Nuclear and Particle Physics

Scientific Mentor:
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FRAGOPOULOU MARIANTHI

Radiation Protection Dosimetry using MOSFET

The overall objective of the project is to develop a new innovated system for medical dosimetry, using field effect transistors p-MOSFETs. The system will be used as a real time or passive dosemeter with special specifications in order to collect doses from electrons, photons and neutrons.
The benefit emerging from the implementation of the project is to fabricate a complete measurement system for medical dosimetry based on p-MOSFET with particular characteristics, such as low power consumption, small size and weight in order to be positioned everywhere even inside cavities. These characteristics are very important in medical applications especially in braxy- therapy. The device will be fabricated by an innovated technology in order to be of high sensitivity to different types of radiations as it is the mixed field during the medical applications and capable to discriminate the different types of radiation

Dentech Inc®

Company Mentor: VASILIOS ALEXIADIS | **www.e-dentech.gr**

Molecular Thermodynamics and Modeling of Materials Laboratory

Scientific Mentor:
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GATSIOU CHRISTINA-ANNA

Coarse grain modelling of polysaccharides-clay nanomaterials

Clay based Polymer Nanocomposites (CPN), is a class of materials with a wide range of applications in engineering and manufacturing. The improved performance of CPN compared to their pristine polymer matrixes is attributed to the specific chemistry/structure of their components and the interactions developed between them. Understanding how these factors affect their properties is important for the design of new materials for specific applications. In this respect, molecular simulation can be used in combination with laboratory-based research to optimize the behavior of CPN materials. This project aims to explore by means of atomistic and coarse grained modeling techniques, the factors resulting in the improved properties of CPN based on bio-polymers such as starch and chitosan. Our target is to investigate the effect of the clay particle presence in the adopted system morphology, swelling, diffusion and elastic properties. In addition, we will develop a set of tools for the computational modeling of CPN, facilitating the systematic exploration of the various nanoparticles-polymers combinations and contributing to the development

SCIENOMICS
delivering science

Company Mentor: JÖRG-RÜDIGER HILL | **www.scienomics.com**

Advanced Ceramics and Composites Laboratory

Scientific Mentor:
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GEORGIOPOULOS PANAGIOTIS

Development of novel bio-degradable and recyclable ceramic-filled polymer hybrid composites

The ultimate goal of this project is the preparation of bio-based nano- and micro-structured ceramic-filled polymer hybrids (in particular polylactic acid, PLA) for packaging and other applications with lower environmental impact than hydrocarbon-based polymers. Variations in formulation and processing parameters of the composite materials, can contribute to the capability of tailoring the materials' properties, in order to target specific applications. Resistance to weathering and barrier properties are examples of properties that need to be tailored. Cost minimization and resolving of possible weak points of the bio-based materials are additional challenges for this project. Overcoming obstacles in order for bio-based/bio-degradable materials applications to be extended will lead to a significant contribution to the roadmap towards the gradual replacement of conventional polymers/polymer composites with environmentally-friendly materials.

FLEXOPACK

Company Mentor: Mr. GEORGE ROUSSOS | **www.flexopack.gr**

Computational Intelligence Laboratory

Scientific Supervisor:
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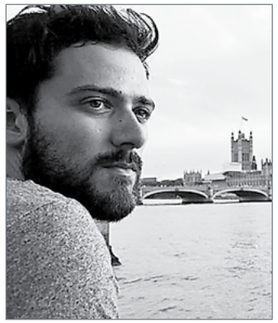
KADDAS PANAGIOTIS

DocCS: Document Classification & Semantic/Sentiment Analysis

The implementation of this project is based on examining two well defined research hypotheses. The first is to create a robust Document Classification System, able to classify and recognize basic information in an amount of various documents such as scanned newspaper articles, journal pages, receipts, invoices or standard forms. Extracting relevant information (document features, keywords and meta-data) from this corpus is necessary, in order to assist later processing steps such as Optical Character Recognition, Monitoring and Data Analysis Systems. The second research task to be examined relates strongly to the Semantic Annotation and Sentiment Analysis of textual information. Assuming that a document image has been converted to its corresponding digitized form and textual information is available, this project aims to define an innovative Semantic Annotation and Sentiment Analysis framework, by blending image analysis and natural language processing techniques, leading to a short but comprehensive description of the textual source.

Company Mentor: GEORGE PISTIKOS | **www.indigital.gr**



Institute of Informatics & Telecommunications

Scientific Supervisor:
Dr. Spyropoulos Constantine

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KAKLIS DIMITRIOS

Financial exergy maximization by calibrating weather routing with FF artificial network

The maximization of exergy in maritime transportation without additional investment just by intelligent reduction of the consumed energy to overcome added resistance due to weather factors; and even more: the transformation of the exergy, technically defined, function to a profit-utility function including the time as well as marketing data, that is the exergy of the corresponding financial system. FF ANN (Feed forward artificial neural network) and big data analytics will be designed and be developed for source-agnostic interoperability, eliminating vessels'-specific consumed time and cost theoretical hydrodynamic model. Algorithms to find the best seaway under calm weather conditions between any two waypoints, that avoids lands, restricted areas, war zones, draft limitations and navigation rules.

Company Mentor: VARELAS TAKIS | **http://web2.danaos.gr**

Molecular Diagnostics Lab

Scientific Supervisor:
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KALFAKAKOU DESPOINA

Development and Optimization of Bioinformatics Tools for Cancer Predisposition Diagnosis

Cancer genetics has become a crucial aspect in the practice of medical oncology. Approximately 10% of all cancers develop in individuals who have inherited a genetic mutation conferring elevated susceptibility to specific cancer types. While these individuals comprise a small proportion of the overall burden of cancer, the ability to distinguish them from 'sporadic' cancer cases permits targeted efforts in cancer surveillance and prevention affecting whole families and future generations. Moreover, these targeted strategies successfully reducing their cancer risks may be generalizable to the broader population. Genotyping such patients has become more effortless than ever with the introduction of Next Generation sequencing (NGS). However, this new technology brings new challenges in terms of data management and interpretation, which can be met with the use of bioinformatics. The proposed PhD study aims in developing and optimizing germline and somatic NGS data analysis pipelines, studying the correlation of germline and somatic genotypes and developing a unique for the Greek population cancer-specific mutation database.

SafeBlood BioAnalytica

Company Mentor: Dr. CHRISTIANA ZYGOURI | **http://www.sbbio.gr/?lang=gr**

Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety

Scientific Mentor:
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KAPLANIS MICHAIL

Rhenium and Technetium Complexes as potencial antitumor agents

The use of metals in drug design is very attractive, as they offer a unique spectrum of reactivity through ligand exchange and redox processes that is not available in the more common organic-based drugs. Recent studies have revealed the efficacy of rhenium complexes as anti-cancer agents. Rhenium compounds in oxidation states (I), (III) and (IV) were cytotoxic in multiple cancer cell lines with cell death proceeding via apoptosis, most probably through interaction of the metal centre with DNA. The objective of the project is to explore the therapeutic potential of Re-complexes by combining multiple anti-tumour components in one molecule: (i) the cytotoxic effect of the rhenium metal centre; (ii) the anticancer properties of a molecule that intercalates with DNA and (iii) the cytotoxic and tumour targeting effect of 2-(4'-aminophenyl)benzothiazole. We aspire that these components will act synergistically to imbue the new molecules with enhanced cytotoxic activity at the tumour site.

ΒΙΟΚΟΣΜΟΣ

Company Mentor: TSOUKALAS CHARALAMPOS | **www.biokosmos.gr**

Environmental Research Laboratory (EREL)

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KATOPODIS THEODOROS

Assessing Climate change resilience in Hellenic Petroleum facilities

Climate related hazards have the potential to substantially affect the lifespan, service level or even cause significant damages to the facilities and operations of Hellenic Petroleum, as in any other petrochemical industry. The impacts to the HELPE, can be devastating, as those to the sustainability of the country's economy, the nearby living communities and the environment. The scope of this project is to derive an innovative framework for supporting the HELPE Infrastructure's resilience to climate pressures, as well to generate scientifically truthful and validated knowledge on the potential impacts of climate on the HELPE operation. An innovative resilience framework will be derived, fusing the knowledge generated in holistic risk and impact assessment, by different alternative options which include (i) Prevention– options to minimise exposure of HELPE to hazards, through the more efficient and effective understanding and prioritizing of potential risk and threats; (ii) Reducing potential impacts – enhance contingency planning and business continuity to ensure alternative supplies, reserve capacity, and / or rapid restoration of services; (iii) Adapting to mitigating risk - investing in protection and defences.

HELLENIC PETROLEUM

Company Mentor: PENELOPE PAGONI | **www.helpe.gr**

Software and Knowledge Engineering Laboratory

Scientific Supervisor:
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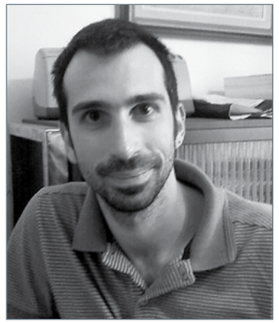
KONTOPOULOS IOANNIS

Distributed Complex Event Recognition and Forecasting

Event processing has been established as a generic computational paradigm in a wide range of applications. Events report on state changes of a system and its environment, thereby enabling reactive and proactive computing. At the core of event processing systems is an event recognition mechanism. It is the ability of a system to detect events that are considered relevant for processing and, as such, is the basis of situation awareness. The goal of this project is the development of generic event recognition technology that may be utilized for maritime surveillance. To deal with the lack of veracity, probabilistic reasoning techniques will be employed. To address data volume, velocity and distribution, novel algorithms for distributed reasoning under uncertainty will be developed. Moreover, to allow for proactivity, event forecasting techniques will be proposed. The generic event recognition and forecasting technology will be evaluated using real data streams from the maritime domain.

MarineTraffic

Company Mentor: Dr. DIMITRIS ZISSIS | **www.wow.gr/marinetraffic.html**



Thermal Hydraulics & Multiphase Flow Lab

Scientific Mentor:
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KOSMADAKIS GEORGE

Integrated solutions for low-temperature waste heat recovery and exploitation in industrial processes

The core objective of the project is to develop advanced processes and integrated configurations for exploiting the industrial waste heat. Focus is given on low-temperature heat (below 100 oC), which represents a large fraction of the total one, since its utilization currently leads to unattractive solutions with long payback period (PBP). Therefore, new technologies should be developed to effectively exploit this heat and increase energy efficiency, with a direct positive impact on the environment and the society. The project deals with the development of integrated solutions for waste heat exploitation, through upgrading the waste heat with a heat pump, storing it and then re-using it. In order to improve flexibility, minimize the rejected heat, and gain an overall control of energy flows, the stored heat can be also used for power production with the same unit (bi-directional process), and thus conclude to a reversible heat pump/organic Rankine cycle.

Company Mentor: Dr. PANTELEIMON BAKALIS | **www.psyctotherm.gr**

Institute of Nuclear and Radiological Sciences, Technology, Energy and Safety

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KOTSILITIS SARANTIS

Hardware accelerated energy disaggregation for energy efficiency and predictive maintenance applications

Monitoring of energy consumption at equipment level is essential to predict the energy needs and the equipment health in a household, a building or an industrial system. Energy disaggregation regards the use of data analytics and signal processing, in order to identify specific patterns and distinguish between individual electric device consumption. This is usually done in a non-intrusive manner by monitoring the utility connection meter, and has been a field of significant research work for several years. The project aims to develop novel tools for energy disaggregation and monitoring of device health status, based on real-time pattern recognition/matchmaking of complex energy load data time-series, and hardware accelerated algorithms. This requires the design, development and implementation of complex algorithms on a Field Programable Gate Array (FPGA), to create a network of distributed agents that performs the majority of the data analysis in real-time, and transmits events, instead of raw data, to a main server. The developed algorithms for events' analysis will be integrated in a cloud platform to share knowledge between agents.

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Ceramics and Composite Materials (CCM) Lab

Scientific Mentor:
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KOUMPOURI DIMITRA

Development of novel cement clinkers with low carbon footprint for industrial production

The purpose of the current proposal is to investigate the production of novel, eco-friendly cement clinkers, with equivalent or improved service (performance) properties compared to the conventional Portland (OPC). This will be achieved by the development of clinker phases that are formed at lower temperatures than the conventional ones and furthermore with the incorporation of lower amounts $CaCO_3$. Towards this direction, the design, production and hydration mechanism of belite-rich cement clinker (BC) and sulfoaluminate belite-rich cement clinker (SABC), will be studied. The qualitative mineralogical composition of BC is similar to OPC, but the main difference lies at the higher proportion of belite (C_2S) and lower alite (C_3S). The development and study of BC will be focused on the reinforcement of early strengths by the stabilisation/activation of hydraulic belite structures through the incorporation of appropriate oxides (B_2O_3, SO_3, K_2O, P_2O_5, Na_2O, and other). In the case of SABC, the development of a cement clinker with main mineralogical phases C_2S, C_4A_3S and $C_2A_xF_{(1-x)}$, will be investigated. Production of the aforementioned alternative clinker phases results in considerably lower CO_2 emissions and energy consumption. In the frame of applied research for industrial scale production of cement, simulation modelling of the kiln process (firing temperature and time, phase changes etc.) for BC and SABC, will be carried out. This is essential for the prediction of the high temperature phases in relation with mineralogy of raw materials and firing conditions at the scale up level. Additionally, a comprehensive assessment on valorisation opportunities of selected solid by-products (metallurgical electric arc furnace slag, red mud, fly ash, etc.) as alternative raw materials for clinker production will be carried out. The utilisation of these by-products in the production of clinker implies a further reduction of emitted CO_2.

Company Mentor: Dr. MARIOS KATSIOTIS | **www.titan-cement.com**

Membranes and Materials for Environmental Separations Laboratory

Scientific Mentor:
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LABROPOULOS ANASTASIOS

Ionic Liquids for Capture and Electrochemical Reduction of Carbon Dioxide into Chemical Products (CO_2-IOLICERP)

The project targets to develop and demonstrate novel efficient and cost-effective materials and processes for post combustion capture of CO_2 from flue gas and integrate the new processes with novel electrochemical processes for conversion of captured CO_2 to produce CO and methanol. The overall objective of the project is to enable using CO_2 as feedstock for industrial value chains, thereby establishing a circular economy by addressing the global warming issue cost-effectively. The overall workplan will be the development, testing and integration of two main processing units: the unit for capture of CO2 from emitted flue gas with the CO_2 electrochemical conversion and recycling unit. The project will use CO_2 separated from flue gas as a feedstock for the electrochemical reduction of captured carbon dioxide, introducing efficient valorization, cascading and management of waste streams applicable to multiple energy intensive sectors. The project will develop and operate a novel electrochemical lab-scale unit, demonstrating the full value chain from the negative value flue-gas to the electrochemical products carbon monoxide and methanol.

Company Mentor: NIKOLAOS KLISSIOTIS | **www.suk.gr**

Institute of Nuclear and Radiological Sciences, Technology, Energy and Safety

Scientific Supervisor:
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MAKRIS DIMITRIS

Optimization of dosimetry for modern radiotherapy techniques for safer and more effective radiotherapy of brain tumors

The main objective of the research proposal is to develop a novel and reliable personalized-pretreatment plan verification (PTPV) method that will overcome the majority of the problems that are currently present in clinical practice, improving in this way the safety and efficiency of modern radiotherapy techniques. The project will be based in 3D-MRI-polymer gel dosimetry, a method that overcomes the great majority of problems of conventional detectors, for high resolution 3D relative dosimetry. Patient specific phantoms that simulate the real patient anatomy will be constructed using a polymer gel substance and 3-D printing technology. The gel-filled phantom can be then treated as the real patient. A comparison between the calculated and experimentally derived 3D dose data will enable the verification of the patient treatment plan, complement and significantly extend the capabilities for personalized-pretreatment plan verification. Moreover, this method will be used to verify and evaluate, novel radiotherapy techniques that use Gold Nanoparticles (GNPs) as contrast agents, that enhance the dose within the PTVs.

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Structural Studies of Biomolecules and Pharmaceuticals

Scientific Mentor:
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MAVROIDI BARBARA

Development of a Radiodiagnostic Agent for Breast Cancer

The main objective of the project is the development of a novel radiodiagnostic agent for imaging of breast cancer with γ-radiation computed tomography (SPECT) that will combine the ideal nuclear properties of technetium-99m (99mTc, γ-radiation), the most commonly used radionuclide in clinical practice, with those of the anticancer agent 2-(4′-aminophenyl)benzothiazole that is known to be selectively taken up and metabolized by sensitive breast cancer cells. The presence of 2-(4′-aminophenyl) benzothiazole is expected to selectively guide the 99mTc-agent to breast cancer tissue, thus allowing the imaging of the tumor through the emitted from 99mTc γ-radiation. The prospect for combined radiodiadiagnostic/radiotherapeutic applications through the use of alternative radioisotopes is tangible. In the market, there exists no specific imaging agent for the early and accurate diagnosis of breast cancer which is the most prevalent cancer in women and the commercial demand for such an agent is high.

Company Mentor: CHARALAMPOS TSOUKALAS | **www.biokosmos.gr**

Envrironmental Radioactivity Laboratory

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MAVROKEFALOU GEORGIA

Study on the relation of radioactive pollution and satellite observations of marine parameters and comparative analysis on a Geographic Information System

The proposed study aims at the creation of an innovative tool for the remote recording of the conservative pollutants in the marine environment, by integration of field measurements, satellite observations and GIS for routine and emergency radiological inventory at first, but also extrapolated to other diluted pollutants too. Therefore, a program has been developed to explore the relations of SST, SSS and Ocean Colour (OC) parameters (Chlor_A, PIC, POC, iPAR and PAR) with 137Cs activity concentrations in the Aegean Sea and analyze them to a GIS platform. SMOS and MODIS time series data are acquired processed and correlated with simultaneous to the satellite passes, measurements of 137Cs activity concentrations, aspiring to result to a conjoint model-scheme for remote survey recording and forecasting. The tool is based on interdisciplinary and cutting-edge technologies and target to early radiological impact assessment for countermeasures to be taken. Furthermore, by induced in the platform biological parameters the effects on both humans and ecosystem could be detected by estimating the dose rate of the ionizing radiation.

GET GEOSPATIAL ENABLING TECHNOLOGIES making location matter

Company Mentor: THEODOROS VAKKAS | **www.getmap.eu**

Materials and Membranes for Environmental Separations Laboratory

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MEGADOUKA DIMITRA

Novel Phytomining production of advanced metal-nanoparticles graphene catalytic membranes

The need for clean and sustainable raw materials production solutions to avoid increasing environmental damage that is caused by mining operations, is of fundamental importance for our economy. Phytomining is applied as a means of removing heavy metals from wastewaters and soils as it aids the development of heavy metal nanoparticles. The overall objective of this project is the reclamation of the metals obtained from phytomining by developing a membrane intensified process for the recovery of the metals in one-step production of advanced metal-nanoparticle graphene catalytic membranes. To this end the main objectives are:
(a) to prepare novel carbon nanotube array membrane distillation (MD) membranes
(b) to concentrate copper and silver ion solutions by MD
(c) to separate the metal ions by Nanofiltration
(d) to anchor the metal ions on the surface of exfoliated graphene and prepare advanced metal nanoparticle-graphene catalytic membranes with predesigned hierarchical nanostructure
(e) to prepare LOW COST antimicrobial coatings graphene decorated with copper nanoparticles.

suk

Company Mentor: KLISSIOTIS NIKOLAOS | **www.suk.gr**

Materials & Membranes for Environmental Separations Laboratory

Scientific Supervisor:
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MICHAILIDI ELISAVET

Study of the effect of nanobubbles enhanced water solutions on the cleaning of stainless steel and ceramic surfaces from oil based contaminants

The purpose of this Industrial PhD project is to elucidate the effects of nanobubble (NB) suspensions, produced by new designed NB generators, and study the nanobubble formation, size distribution, coalescence, stability and dynamic behavior. Aqueous NB suspensions will be examined regarding the properties of nanobubbles and their applications on cleaning and preventing depositions mainly on stainless steel and ceramic surfaces. This project is expected to contribute to the optimization of oil transfer/storage process by developing an innovative method for cleaning the tanks from organic deposits. The oil based contaminants removal, which requires large amounts of surfactants, is a high demanded process because of the required high water temperature and the wastewater has an even higher organic load.
The project will provide an energy efficient technology, which follows the principles of green chemistry to mitigate the environmental effects of the cleaning process.

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Materials for Nanolithography and Organic Electronics Lab

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NIAKOULA DIMITRA

Adhesive polymeric materials and non-destructive characterization methods for abrasive coatings

The main goal of this project is to develop functional thermosetting polymeric adhesives, both solventborne and waterborne suitable for coating on flexible substrates. A significant part of the project is devoted to the development of a waterborne adhesive applicable on waterproof paper substrates targeting to environmentally friendly solutions. The adhesive systems will be developed by formulating thermosetting polymeric materials for achieving coated abrasives through thermal curing. Basic parameters of the formulations to be developed include type and form of the adhesive, curing agent and curing chemistry, curing temperature and pot life. Industrial procedures will be applied for the ultimate testing of the coatings properties.
The project is further aiming at gaining an improved insight on the relation of adhesive composition and physicochemical parameters that affect the performance of the abrasive product. Towards the above goal a set of specific measurements will be adopted including thermal techniques, spectroscopic methods and surface characterization technologies to correlate grain topography and adhesive composition with performance.

Company Mentor: ANDREAS GERASIMOU | **http://smirdex.gr**

Radiation Protection Laboratory: Health, Physics, Radiobiology & Cytogenetics

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NIKOLAKOPOULOU AGGELIKI

Development and validation of radiation cytogenetic assays to predict individual radiosensitivity and optimize personalized radiation therapy

Although rapid technological advanceshave led to a more precise delivery of radiation dose and to a decreased risk of side effects, there is still a significant need for personalized treatment to be achieved through the development of predictive tools that may guide therapy decisions. Indeed, the identificationof patients that are sensitive or resistant to RT could be used as a basis for tuning the appropriate therapeutic radiation dose for individual patients, optimizing thus the therapeutic gain in cancer treatment. Our aim is to develop and validate a reliable G2-chromosomal radiosensitivity assay (G2-assay) for personalized radiation therapy purposes and the prediction of individual radiosensitivity in clinical practice as well as to investigate the potential of combining radiation therapy with G2/M-checkpoint abrogators in vitro, e.g. caffeine or hyperthermia, to overcome radiation resistance of tumours and examine the molecular mechanisms involved. Finally, the efficiency of advanced radiotherapy techniques such as VMAT and IMRT delivered by Elekta linear accelerators is to be evaluated, using phantoms in conjunction with conventional as well as advanced cytogenetic techniques.

Elekta

Company Mentor: JOHN GRANT | **www.elekta.com**

Radioactive Materials Management Laboratory

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NTALLA ELENI

Development of a Time and Cost Effective Technology for Radiological Characterization/ Segregation of Radioactive and NORM Waste

At the moment the existing technologies regarding characterization and segregation of raw radioactive waste in classes are not affordable for countries with low amounts of radioactive waste like Greece. Regarding the NORM waste the radiological characterization and segregation is necessary for cost effective management and radiation protection of the personnel. The innovative potential of the proposed doctorate thesis is the development of a low cost, fast, cost effective and friendly to user technology for characterization and segregation of raw radioactive waste, based on the non-destructive gamma spectrometry. The technology will facilitate targeted sampling from radioactive waste items as well as radiological characterization and segregation of raw radioactive waste into classes of different management route. The application of the technology can be extended for: (1) radiological contaminated soil, (2) solidified radioactive waste, (3) NORM waste in situ characterization, which are part of the waste management services of Polyeco A.E.

polyeco waste management

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Wireless Communications Laboratory

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NTONTIN KONSTANTINOS

Practical Design for Highly Spectral Efficient mmWave MIMO Transceivers

The objective of the project is to design and implement novel low-complexity signal processing algorithms for the main hardware components of multiple-input-multiple-output (MIMO) transceivers operating at millimeter-wave (mmWave) bands. Intracom S.A.Telecom Solutions has the intention to incorporate such transceivers into its products related to wireless backhaul/fronthaul and broadband access applications in the networks of its customers. This is going to substantially increase the achieved spectral efficiency of its currently deployed products, which is essential so that the rate demands of the forthcoming 5th generation (5G) of communications are met.

INTRACOM TELECOM

Company Mentor: Dr. NIKOLAOS D. SKENTOS | **www.intracom-telecom.com**

Molecular Thermodynamics and Modeling of Materials Laboratory

Scientific Mentor:
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PAPAVASILEIOU KONSTANTINOS

Mesoscale Modelling of Fischer-Tropsch Product Mixtures Confined in Graphene Nanopores

The Gas-To-Liquids (GTL) process is an established, robust and economically viable technology in harnessing gas resources, such as synthetic gas for the efficient production of cleaner and high-quality transportation fuels by the petrochemical industry. The Fischer-Tropsch (FT) reaction is fundamental to the fuel production process and its performance is controlled by several factors, such as operating conditions, the choice of the metal catalyst and its support material. These factors affect operational costs and their underlying mechanisms are yet unknown. This project aims at the utilization of mesoscale molecular simulation methodologies on the production of fundamental knowledge in conjunction to the company's goals, in order to address a number of fundamental questions raised by the company's GTL industrial partners.

SCIENOMICS delivering science

Company Mentor: JÖRG-RÜDIGER HILL | **www.scienomics.com**

Plasma Nanofabrication Lab

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PAPAVIEROS GEORGE

Computational Nanometrology with applications in Nanoelectronics and Nanotechnology

The project's objective is the development of theoretical and computational methods for the characterization of micro and nanostructures through the analysis and simulation of electronic and atomic microscopy images. The nanostructures to be investigated are either the building blocks of semiconductor industry, used in integrated circuits (nanoelectronics) or derive from other areas of nanotechnology such as smart surfaces, biomaterials, photonics etc. The target of this project is to achieve the mathematical innovation needed to provide the computational tools for the accurate and complete metrology of the morphological complexity of such nanostructures. The project will focus on and add value to: a) the measurement accuracy, b) the morphological complexity of nanostructures. All of the above will lead to the improvement of Nanometrisis existing metrological software, as well as the development of new codes and algorithms, in order to enrich the software family and widen the company's commercial target spectrum.

Company Mentor: Dr. VASSILIOS CONSTANTOUDIS | **www.nanometrisis.com**

Membranes and Materials for Environmental Separations Laboratory

Scientific Mentor:
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PERDIKAKI ANNA

Membranes for stevia glucosides separation and purification

Stevia plant is likely to remain a major source of noncaloric sweeteners for the growing natural food market in the future. But, although sales were doubled in the last 4 years, the bitterness and characteristic aftertaste of steviol glycosides is still an issue to be addressed. To date, processes for preparing high purity steviol glycosides such as HPLC and TLC have small handling capacity and high cost making them less than preferable for industrial production. On the other hand, membrane separation could constitute a promising alternative due to its low cost and ease of application and upscalability. The objective of this proposal is to apply membranes for the separation and purification of steviol glycosides targeting high yield, higher efficiency and lower operating cost than already existing technologies.

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Software and Knowledge Engineering Laboratory

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PITTARAS NIKIFOROS

Beyond Deep Learning

The goal of this project is to propose novel machine learning methods across a multitude of problems such as classification, clustering and summarization. We investigate two important aspects of learning systems. Firstly, we look into data representations for different modalities, as well as multi-modal data. We compare different approaches and fusion schemes evaluating performance, expressiveness and applicability per problem. Secondly, we examine the architecture, training and performance of modular learning models such as neural networks and their expansion with non-traditional components that directly take into account statistical and/or semantic information of their input.
The findings of our research will be merged into a novel learning pipeline bearing advantages to the current state of the art. This work will enable the wealth of semantic and statistical research to complement the potential of neural networks and support a holistic view of learning, beyond the borders of a specific learning implementation.

Company Mentor: NIKOS SARRIS | **www.atc.gr**

Wireless Communications Laboratory (WiCom)

Scientific Mentor:
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SEIMENI MARIA

Study of the human Exposure to electRomagnetic fiElds of wearable aNtEnnas (SERENE)

Motivated by the public concern regarding the exposure of the human body to the electromagnetic (EM) field generated by the antennas used in wearable devices, our aim is to come up with a methodology to reduce the EM field to the direction of the user's body without significantly degrading the antenna performance. This study primarily includes antenna design techniques and methods to reduce the absorbed power by the human body and this way drive down the Specific Absorption Rate (SAR). The proposed antenna models will be examined and evaluated through a measuring procedure that will be developed for this purpose. Proper measuring setups and EM phantoms simulating a typical human body will be also developed. At the end of the day, the conformity of the antennas specifications of the wireless monitoring system used in HYGEIA hospital (where Singular Logic is IT service provider) with the project's results will be checked.

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Environmental Research Laboratory (EREL)

Scientific Mentor:
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SIDERIS ANARGYROS

Advanced Surveillance Platform in the Cloud and IoT EraS (ASPIS)

ASPIS main objective consists on designing, developing and evaluating a cost-effective, intelligent and IoT aware surveillance platform able to detect anomalous incidents and evaluate them as indicators for possible threats to critical facilities, infrastructures and people. To this end ASPIS will build on two systems, namely the Cloud and the Embedded. The latter, installed at the networks edges, will collect the data stemming from IoT sensors (e.g. video, audio, CBN) and then perform on them, in real-time, some lightweight analysis. The former will enable to harness the abundance of processing and storage resources for performing more sophisticated analysis, visual analytics and decision support operations, besides enabling for a more efficient coordination of the remotely deployed embedded systems and attached sensors. Acknowledging the severe stress that would cause to the networks the act of forwarding, from the Embedded systems to the Cloud, all of the collected data, the embedded systems will use the outcome of their lightweight analysis for deriving a forwarding decision.

Future Intelligence
TELECOM ENGINEERING COMPANY

Company Mentor: NIKOLAOS ZOTOS | **www.f-in.gr**

Functional Nanomaterials of Organized Structure Lab

Scientific Mentor:
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KONSTANTINOS SPYROU

Development of novel carbon-based nanofillers for advanced functional nanocomposite coatings

This project involves the preparation and characterization of functional carbon nanoparticles for the development of novel epoxy-based nanocomposite coatings. Novel carbon nanomaterials with 1-D, 2-D and 3-D structure exhibiting exceptional properties will be synthesized and modified by Demokritos and Glonatech in order to achieve great dispersion of the carbons in epoxy resins. Excellent quality multi-wall carbon nanotubes, graphene oxide and a very new member on the family of carbon allotropes called as Carbon Cuboids with intriguing properties will be synthesized. Modification of carbon nanostructures using functional and multi-functional dendritic polymers will take place rendering them compatible with polymeric matrices inducing new or enhanced properties to the final nanocomposites such as hydrophobicity, flame retardancy, durability and UV-resistance. Characterization studies on the modified nanofillers as well as on the developed epoxy nanocomposites will be carried out. The obtained structural characteristics will be related to the overall materials' performance to promote the synergistic effect of nanofillers. The materials exhibiting the most promising properties will be produced in large-scale and provided for application as top coating on marine, automotive and aerospace applications.

GLONATECH

Company Mentor: Dr. STEPHANOS NITODAS | **www.glonatech.com**

Environmental Research Laboratory (EREL)

Scientific Mentor:
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STAMATAKIS EMMANUEL

Smart Hybrid Energy Storage And Management (SHESAM)

The main objective is to increase the share of local RES used in the building sector, by integrating energy storage and management systems. The project will demonstrate innovative solutions for local power and heat generation and their appropriate integration with energy storage in the form of hydrogen (Power to Gas) to enhance renewable energy penetration in the built environment. The addition of Hydrogen Energy Storage Systems (HESS) and Thermal Energy Storage Systems (TESS) increases the system flexibility and efficiency.

Direct outcomes envisaged to be achieved during the project are:

1. substantially increased exploitation of RES in the built environment;
2. provision of a real case methodology for co-operation between hydrogen storage & RES installations;
3. quantifications of the social, economic and environmental benefits of energy storage applications;
4. Increase public acceptance of Smart Hybrid RES-energy storage systems.

Company Mentor: Mr KONSTANTINOS TSIAKATARAS | **www.diadikasia.gr/**

Company Mentor: Dr NIKOLAS YANNOULAKIS | **www.elfon.gr/**

Energy Harvesting and Autonomous Sensors Group

Scientific Supervisor:
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STRAMARKOU MARINA

Smart Packaging using electronic sensors on flexible substrates for the activation of food bioactive compounds encapsulated with innovative methods

The main objective of the Industrial PhD project is the development and evaluation of technologies for food preservation and smart packaging reinforced with bioactive compounds from industrial waste, targeting fruit juice products. Specifically, the bioactive compounds that are contained in the industrial waste will be recovered and isolated through innovative techniques and then will be encapsulated in the packaging system. In addition, chemical sensors, which monitor food quality and provide information to the user, will be developed and integrated in the same smart packaging system. The quality characteristics of the developed system will be investigated and the extended shelf-life of the new products will be determined. Finally, the sustainability and the total cost of fabrication process of the packaged system, which will be integrated in the current food packaging industrial procedures, will be evaluated. Thus, the Project will resolve two major issues in food industry with societal and economic impact: a) Protection of consumers from spoiled food and b) reduction of industrial food waste.

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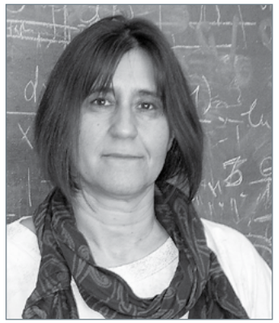

Nanofunctional and Nanocomposite Materials Lab

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TODOROVA NADIA

Novel 2D Nanocrystals for Smart Coatings Applications

This project works at the interface between materials science, surface chemistry and nanotechnology and will be carried out in collaboration with NCSR D and NanoPhos S.A. The goal of the project is to develop new family of 2D Nanostructures with extraordinary properties and to implement them immediately in smart, functional coatings. 2D nanostructures as well as their nanocomposites will be firstly synthesized and characterized at NCSR D. The advanced materials will be then incorporated in suitable matrices already used by NanoPhos S.A. Highly effective conductive, photocatalytic and antibacterial formulations will be created at low active component loadings. The deposited coatings will be thin, light and applicable to devices of different shapes and sizes for portable, flexible and wearable electronics. Also, second generation antistatic, photocatalytic and antibacterial coatings will be developed. It is expected the coatings to reach a wide share of users as they can be deposited via environmentally friendly and highly competitive application procedure over new and existing/functioning platforms.

NanoPhos Pioneering Nanotechnology

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Environmental Research Laboratory (EREL)

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TOLIAS ILIAS

Turbulent combustion modeling for explosion safety assessment in real scale industrial geometries

Safety assessment of potential explosion accidents is conducted in industrial areas where flammable gases and vapors are processed in order to predict the resulting explosion overpressures. This assessment is usually carried out using simple integral codes, such as Phast. These codes require crucial input parameters which may have great impact on the overpressure predictions especially in case of complex geometry. The purpose of the project is to improve the predictive capabilities of these models in explosion scenarios in complex industrial areas using the more advanced and accurate Computational Fluid Dynamics (CFD) methodology. In this context, the main objectives of the project are two. First, to further develop and validate existing CFD methodologies/models against experiments in complex obstructed/confined environment. Second, to optimize/develop guidelines for integral code input data in the cases of explosion in complex industrial areas based on the CFD methodology.

HELLENIC PETROLEUM

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Institute of Biosciences and Applications

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TROHATOU OURANIA

Podocyte and β-cell survival in diabetes mellitus: The role of Liraglutide

The proposal focuses on a novel anti-diabetic regiment, liraglutide, recently introduced by Novo-Nordisk. Liraglutide is a long acting, fatty acid-derivative of GLP-1 that shares amino acid sequence identity to native human GLP-1 and ensures a prolonged period of action in vivo thus rendering liraglutide as a good candidate for diabetes treatment. The primary objective of the proposed program is to extrapolate the molecular mechanisms involved in preventing podocyte and β-cell apoptosis by assessing the mechanism of action of liraglutide on the expression patterns of specific long non-coding RNAs that sensitize podocytes and β-cells to apoptosis during the initial phases of the disease. Our secondary objective involves investigation of the mode of action of liraglutide on the process of regeneration of β-cells from mesenchymal stem cells (MSCs). The proposed work shall lead to a better understanding of specific aspects of liraglutide actions at the molecular level and is likely to promote the wider use of liraglutide not only as an anti-diabetic agent but as an important and novel contributor in regenerative medicine.

novo nordisk

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Membranes & Materials for Environmental Applications

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TSOUFIS THEODORE

Innovative Nano-enabled technical Fabrics by incorporation of advanced multi-functional fillers (NanoFabulous)

NanoFabulous aims at the development of innovative nano-enabled technical textiles based mainly on polypropylene (PP) and polyethylene (PE). The project involves the collaboration between Thrace Nonwovens & Geosynthetics S.A. (member of Thrace Plastics Group) and Institute of Nanoscience & Nanotechnology (National Center of Scientific Research "Demokritos"). The main scientific/ technological objectives of the project are the preparation of advanced functional fillers namely (Graphene-based and Inorganic Nanotubes), and their successful incorporation into PP and/or PE carrier. The introduction of those multi-functional, nano-structured additives into pre-selected technical textiles which exhibit great market potential, is strongly expected to enhance their i) Mechanical properties, ii) Flame retardancy, iii) UV-resistance, and iv) Electron conductivity.

THRACE GROUP
A WORLD OF MATERIALS & SOLUTIONS

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Institute of Biosciences and Applications

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TSOUNIDI DIMITRA

Fast & accurate diagnosis of sepsis at the point-of-care with label-free biosensors

Sepsis, one of the leading causes of death worldwide, occurs when a local microbial infection spreads into blood circulation triggering a vigorous inflammatory response. This response can result in multiple organ failure which is usually fatal. Thus, early diagnosis is the only way to increase the survival rate. The aim of this project is the development of a multi-analyte optical label-free biosensor based on White Light Reflectance Spectroscopy (WLRS) for sepsis diagnosis through the rapid and accurate determination of a panel of three analytes related to sepsis in whole blood samples. The targeted analytes are C-reactive protein, procalcitonin and inteleukine-6. The simultaneous determination of these markers is essential to sepsis diagnosis. In combination with the overall clinical picture of the patient could help to manage successfully the treatment. The sensor will be accompanied by a compact small size instrument with automated data processing appropriate for Point-of-Care testing.

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Circuits and devices for sensor networks and systems Lab

Scientific Mentor:
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TSOUTI VASILIKI

Microsystems for obstructive sleep apnea treatment

The ultimate goal of this project is the development of an automated and comfortable wearable system for the non-invasive treatment of obstructive sleep apnea (OSA) through the electrical stimulation (ES) of the genioglossus muscle. The system will incorporate a flexible sensitive strain sensor that will be able to monitor breathing during sleep. The sensor will attach to the skin of the patient, preferably in the region of the neck, close to the larynx and will be connected to appropriate electronics for triggering the electrical stimulation whenever a reduction or a cessation of the airflow is identified. Apart from the development of the sensor, the work will include the study of the electrode characteristics and triggering patterns as well as the system integration and its algorithms. OSA is a common undiagnosed disorder that strongly affects health and quality of life when untreated. In addition, there is a current need for high efficacy therapies and increased long-term patient compliance. The proposed system anticipates addressing this need serving both as a stand-alone system or combined with oral appliances for OSA. When combined with oral appliances, enhancement of the effectiveness and reduction of side effects of the oral appliance therapy are expected.

Company Mentor: K. TSOUTIS | **www.sleepmedicine.gr**

Thin films by chemical vapor deposition and atomic layer deposition Lab

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VOURDAS NIKOLAOS

Smart surface functionalization for high added value ceramic powders and structures (ADVANCER)

The main objective of ADVANCER is to provide and assess means to add value on ceramic powders and structures, through smart surface functionalization, towards various applications. Two methods of surface functionalization will be followed: (i) F-containing monolayers, for tuning wetting-related and tribological properties and (ii) ultra-thin metal oxide and sulphide films, for tuning electrical, optical, tribological, and catalytic properties. With these surface functionalization methods the core properties of ceramics will be remained intact, while their surface will exhibit additional, tailor made functionalities. Applications of the functionalized high added value ceramics will be demonstrated, as indications for new markets in the fields of Catalysis, Environment, Energy and Optics.

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Nanotechnology processes for solar energy conversion and environmental protection Lab

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VOURNA POLYXENI

Robust Antifouling Composite Technology

The RACkET (Robust Antifouling CompositE Technology) project aims at developing a novel conductive composite with enhanced photocatalytic activity for the formulation of highly effective and robust ecofriendly coatings for ships' hulls. These will possess a dual function, acting as antifoulants in static conditions and as both antifouling and foul-release coatings during ship's movement. Antifouling properties will be promoted by polyaniline nanorods decorated by TiO2 nanocatalysts, while the out-of-plane configuration of carbon nanofibers filled with magnetic nanoparticles will promote foul-release phenomena.

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Laboratory of Health Physics, Radiobiology & Cytogenetics

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ZACHAKI SOPHIA

Identification of genetic biomarkers associated with endometriosis-related infertility and malignant transformation

Endometriosis is one of the most common gynecological diseases and its prevalence increases to 50% in infertile women. Laparoscopy is the primary surgical choice for the diagnosis and treatment of endometriosis. The main aim of the proposed study is the identification of microRNA biomarkers for non-invasive diagnosis of endometriosis as well as cytogenetic biomarkers for early identification of women with endometriosis who are in danger for malignant transformation. The identification of specific miRNA biomarkers for the diagnosis of endometriosis is expected to allow the Genesis Athens Clinic to design new diagnostic services.

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Institute of Nanoscience and Nanotechnology

Scientific Mentor:
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ZISIS GRIGORIS – KONSTANTINOS

Accurate thickness and refractive index mapping of 2D materials by reflectance spectroscopy and imaging techniques (SLICE)

Graphene and other two-dimensional (2D) materials are currently subjects of intense research interest all over the world, due to their unique physical properties that are expected to revolutionize a number of fields, such as electronics, photonics, and plasmonics. To enable commercialization of such materials, accurate non-destructive surface monitoring and characterization is required in order to standardize a reliable mass production process.

The core objective of the SLICE project is the development of a radical optical approach for precise characterization of 2D materials (e.g. graphene, graphene oxide, fluorographene, 2D chalcogenides and heterostructures), in terms of number-of-layers and refractive index, in order to facilitate and speed up their implementation in novel industrial applications.

The specific technical objectives of the project are:

a) To provide a simple yet powerful surface analytical technique based on reflectance spectroscopy in a broad wavelength range (UV-Vis-NIR) and a variation of optical reflection microscopy.
b) The development and validation of measuring and modelling tools to correlate the structural and optical characteristics of 2D materials in industrially relevant environments.

Through the project and the collaboration with NCSR 'Demokritos' groups, the company will penetrate further in the Global Thin-film Metrology Systems market increasing both the profit of the company and the related workforce.

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