NEW PERFORMANCE IMPROVEMENT TECHNIQUES OF CONTROL SYSTEMS USING EXPERIMENT-BASED TUNING

Goal of the project

- Development of advanced control structures for automotive and mechatronics applications.
- Improvement and development of new Takagi-Sugeno (T-S) fuzzy models and control solutions for a wide range of industrial processes, mechatronics, mobile robots and automotive applications.
- Optimal tuning of fuzzy models for automotive and mechatronics applications.
- Improvement and development of control algorithms for mobile robots.

Short description of the project

Advanced control structures and optimal tuning of fuzzy models for a wide range of industrial processes are offered.

Project implemented by

Department of Automation and Applied Informatics of UPT as the P2 partner, coordinator: University of Craiova, P1 partner: Moara Calafatului, P3 partner: "Lower Danube" University of Galati, director: Prof. Dr. Eng. Dan Selisteanu (University of Craiova).

Implementation period

2014-2017

Main activities

- Development and experimental validation of simple T-S fuzzy models, evolving fuzzy models and advanced controllers (2-DOF, predictive and fuzzy) for processes in automotive and mechatronics: anti-lock braking systems, nonlinear DC drive servo systems, magnetic levitation systems.
- Continuous development of the nRobotic platform for path planning and collision avoidance of mobile robots in missions.
- Modeling, simulation, analysis and development of: T-S PD + I fuzzy controllers, 2-DOF linear and fuzzy controllers, hybrid T-S fuzzy controllers for speed and position control of brushless DC drives with variable parameters and inputs.
- Optimal tuning of parameters of T-S fuzzy models using nature-inspired algorithms: charged system search, grey wolf optimization, gravitational search algorithms.

Results

Results in 2017:

- 2 papers published in Clarivate Analytics Web of Science (WoS) journals with impact factors.
- 2 papers published in conference proceedings indexed in WoS.
- 2 papers published in conference proceedings indexed in international databases.
- More than 50 independent citations in 2017.

Applicability and transferability of the results

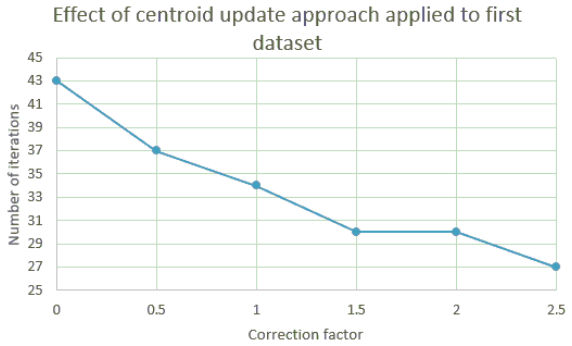
- Nature-inspired evolutionary-based optimization algorithms in modeling and control design.
- Cost-effective solutions for control problems in mechatronics, electrical drives, automotive and robotics.
- Tools for the modeling, optimization and design of fuzzy control systems.
- Real-time programming and operating systems for control and robotics.

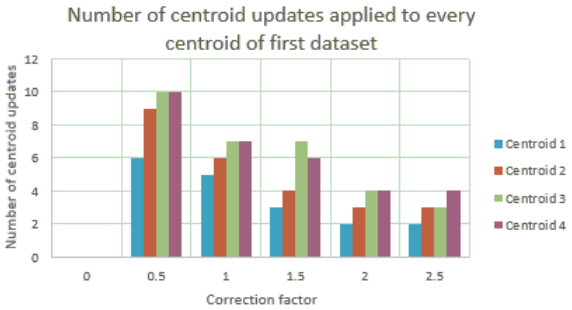
Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Bucharest, Romania.

Research Centre

Automatic Systems Engineering Research Centre (CCISA).
http://www.aut.upt.ro/centru-cercetare/index.EN.php





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Lect. Dr. Eng. Mircea-Bogdan Rădac,
Lect. Dr. Eng. Claudia-Adina Bojan-Dragoș,
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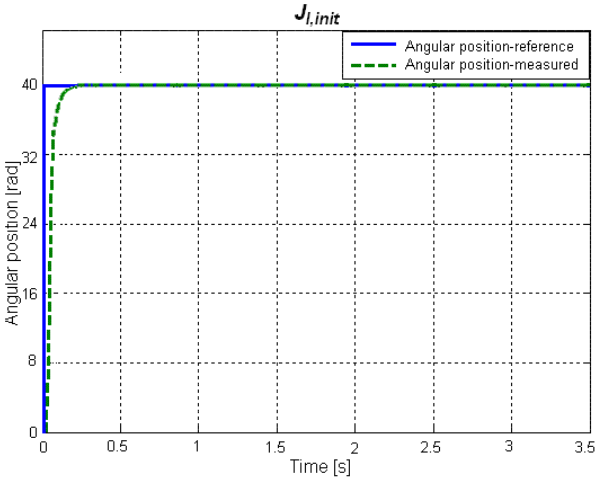

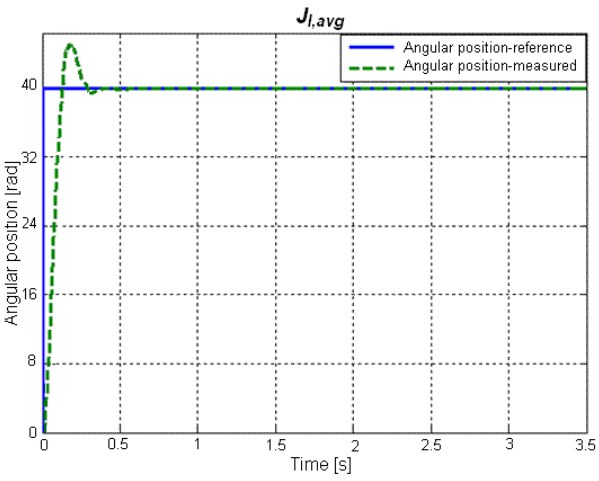

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ADVANCED CONTROL SYSTEM OF A BIOREFINERY PLANT (BIOCON)

Goal of the project

- Enhancement and development of data-based (data-driven) techniques and algorithms for improving control system performances using experimental data.
- Enhancement and development of nature-inspired algorithms n optimization of control system performance.
- Development of optical character recognition (OCR) applications.
- Development of new fuzzy control solutions for a wide range of industrial processes.

Short description of the project

Enhance existing techniques, develop new ones for data-based control system performance improvement.

Project implemented by

Department of Automation and Applied Informatics of UPT as the P2 partner, coordinator: "Lower Danube" University of Galati, P1 partner: University of Craiova, P3 partner: S.C. Teamnet Engineering S.R.L – Galati, director: Prof. Dr. Eng. Sergiu Caraman ("Lower Danube" University of Galati).

Implementation period

2014-2017

Main activities

- Application of Iterative Feedback Tuning (IFT) to controller tuning for nonlinear control systems.
- Model-Free Adaptive Control strategies applied to aerodynamic systems.
- An experiment-based approach to Reference Trajectory Tracking optimal control problem with constraints.
- Validation of iterative techniques on laboratory equipment: liquid level control, motion control systems with motor actuation (speed and position control).
- Enhancement of control systems performance by fuzzy control, IFT and nature-inspired optimization algorithms.
- PI and fuzzy controller tuning to ensure a reduced process parametric sensitivity.
- Improve the training algorithm of Convolutional Neural Networks using mixed Back-Propagation and nature-inspired optimization algorithms.

Results

Results in 2017:

- 2 papers published in Clarivate Analytics Web of Science (WoS) journals with impact factors.
- 2 papers published in conference proceedings indexed in WoS.
- 2 papers published in conference proceedings indexed in international databases.
- More than 30 independent citations in 2017.

Applicability and transferability of the results

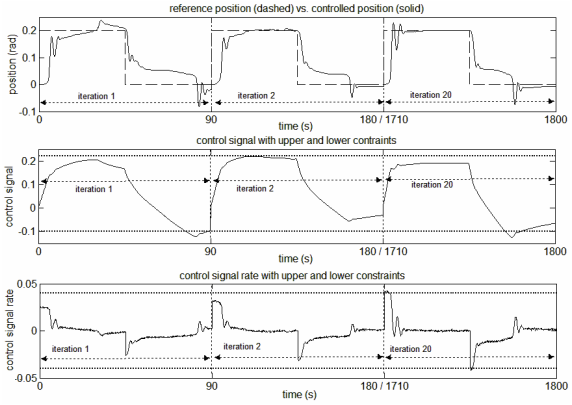
- Control systems with a reduced parametric sensitivity.
- Tools for the computer-aided design of controllers.
- Computer-aided techniques in iterative data-based control.
- Nature-inspired optimization algorithms in control design and image processing.
- Tools for the systematic development of fuzzy control systems.

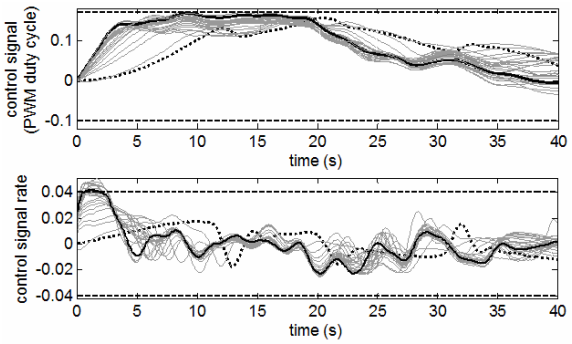
Financed through/by

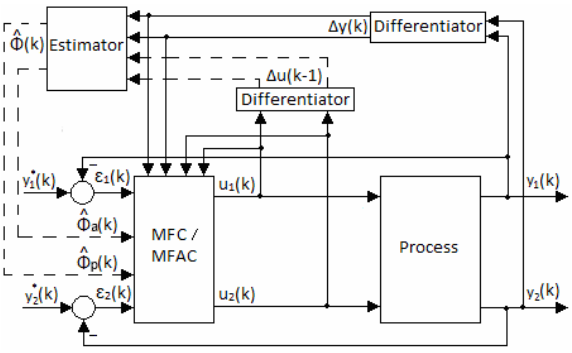
Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Bucharest, Romania.

Research Centre

Automatic Systems Engineering Research Centre (CCISA).
http://www.aut.upt.ro/centru-cercetare/index.EN.php







Research team

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Assist. Lect. Dr. Ing. Alexandra-Iulia Szedlak-Stînean,
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PhD student M.Sc. Dipl. Ing. Lucian-Ovidiu Fedorovici.

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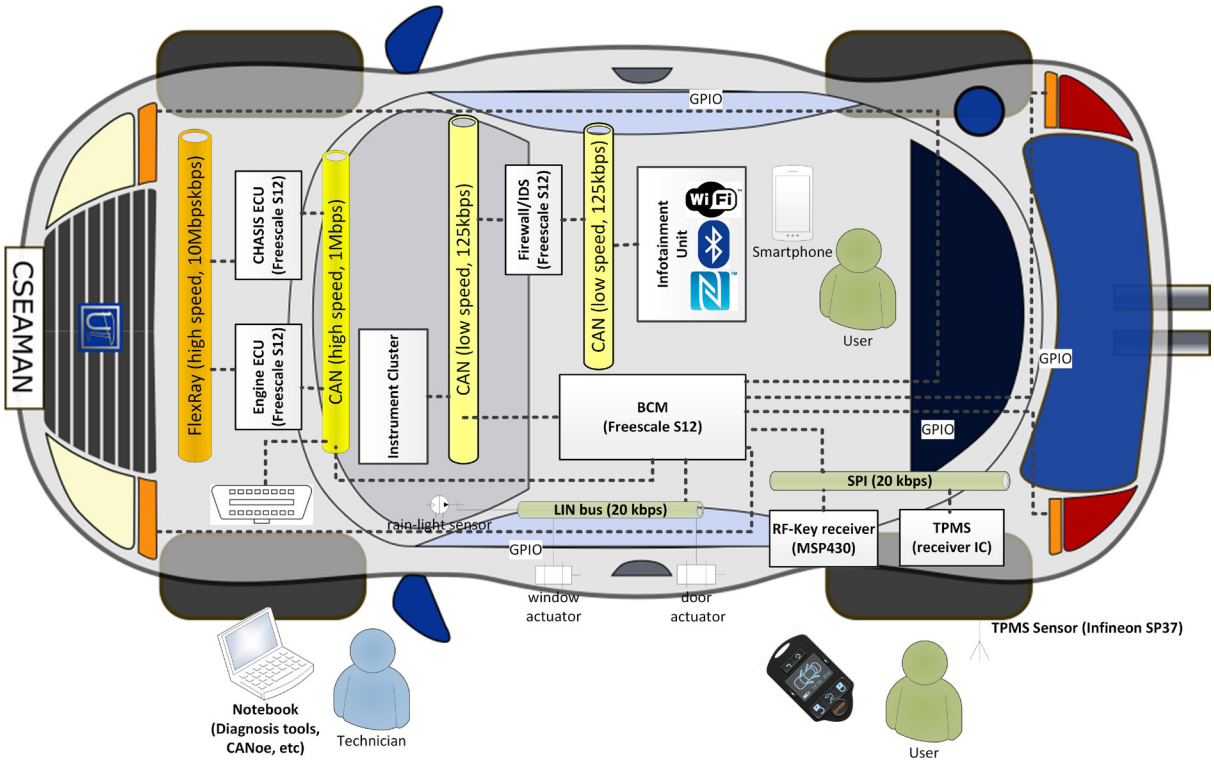
CSEAMAN - CRYPTOGRAPHIC SECURITY FOR AUTOMOTIVE EMBEDDED DEVICES AND NETWORKS

Goal of the project:

The design and analysis of cryptographic security solutions for automotive embedded devices and networks



Short description of the project:

The project aims at the design and analysis of cryptographic security solutions with applications in the automotive domain. Our main challenge is to accommodate cryptographic security on automotive-grade devices with low computational and memory resources that communicate over in-vehicle networks with constrained bandwidth. We focus both on wired and wireless channels that open cars to outsiders and bring a complex adversarial setup. Existing security sub-systems in cars (e.g., wireless keys, TPMS units) are also within reach.

Project implemented by

Research Group on Embedded Systems and Security, Department of Automation and Applied Informatics, Faculty of Automatics and Computers (UPT)

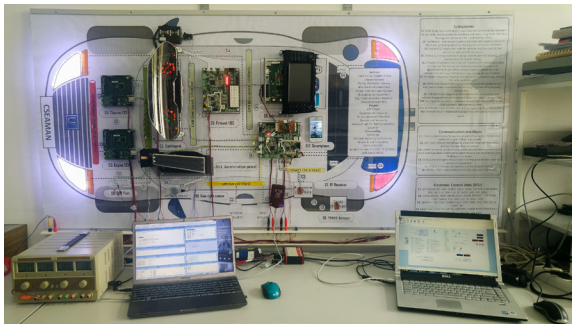
Implementation period:

Oct. 2015 – Sept. 2017

Main activities:

- Implementation and security analysis of cryptographic functions on automotive grade embedded devices, e.g., AUTOSAR compliant cryptographic libraries,
- Design and analysis of cryptographic protocols for wired in-vehicle networks, e.g., CAN bus, J1939, FlexRay, etc.
- Design and analysis of cryptographic protocols for wireless in-vehicle connectivity, e.g., RF keys, TPMS systems, etc.
- Implementation of an experimental platform for security critical subsystems inside the car: communication buses linking various ECUs with potentially insecure third-party devices (e.g. infotainment units)
- Risk analysis and security implications within new automotive paradigms: optimized traffic flows, vehicle-to-vehicle communications, etc.

Results:



- An experimental model for in-vehicle networks and subsystems
- Comprehensive performance analysis of cryptographic functions on automotive-grade controllers
- Analysis of fingerprinting and randomness extraction mechanism from SRAM state
- Design of new security solutions for wireless vehicle access
- Design of new security solutions for the CAN bus
- Security analysis and fixes for the J1939 commercial-vehicle bus protocol
- Analysis of traffic models with adversarial vehicle behavior
- Risk analysis and security implications for attacks on BCM units and vehicle instrument clusters

Applicability and transferability of the results:

Various applications in the automotive industry for securing critical vehicular systems and networks, e.g., wireless keys, CAN bus, ECU fingerprinting, etc.

Financed through/by

Romanian National Authority for Scientific Research and Innovation (CNCS-UEFISCDI) Project No. PN-II-RU-TE-2014-4-1501

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LEARNING TECHNIQUES FOR IMPROVING CONTROL SYSTEMS PERFORMANCE USING MODEL-FREE APPROACHES (LTIPERFORM)

Goal of the project:

The main objective of this proposal is to develop the necessary tools, algorithms and theoretical framework in order to induce the learning-predictive behavior for control systems using model-free control approaches. Several reference input-controlled output behaviors are memorized as primitive tasks inside a library. The primitives are used in predicting the optimal behavior of the control system when a new complex task is to be executed. A planning mechanism similar to a brain will be built in order to achieve this task.

Short description of the project:

The proposed techniques endow contr0l systems with learning and planning features.

Project implemented by

Department of Automation and Applied Informatics of Politehnica University of Timisoara
http://mbradac.info/te2015.html

Implementation period:

2015-2017

Main activities:

- Improvement of data-based (or data-driven) techniques and their combination for obtaining improved capabilities.
- Development and validation of a primitive-based learning and planning strategy for feedback control systems.
- Validation of the proposed theoretical approaches on real-world processes such as laboratory equipments.
- Dissemination of research results in highly visible journals and conferences.

Results:

Results in 2017:

- 3 papers published in Thomson Reuters Web of Science journals with impact factors;
- 6 papers published in conference proceedings (to be) indexed in international databases (ISI, IEEE Xplore, INSPEC, Scopus, DBLP);.

Applicability and transferability of the results:

Owing to the generality of the proposed theoretical framework, the primitive-based learning and planning approach for achieving optimal behavior can be applied to various (feedback) control systems such as mechanical, electrical, chemical, biological, or combinations of the above, in order to enhance them with optimal behavior ability in situations or scenarios never seen before. Thus, they imitate the living organisms. The results also connect several perspectives from the areas of feedback control and machine learning.

Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Bucharest, Romania.

Research Center

Automatic Systems Engineering Research Centre (CCISA)
http://www.aut.upt.ro/centru-cercetare/index.EN.php

Research team

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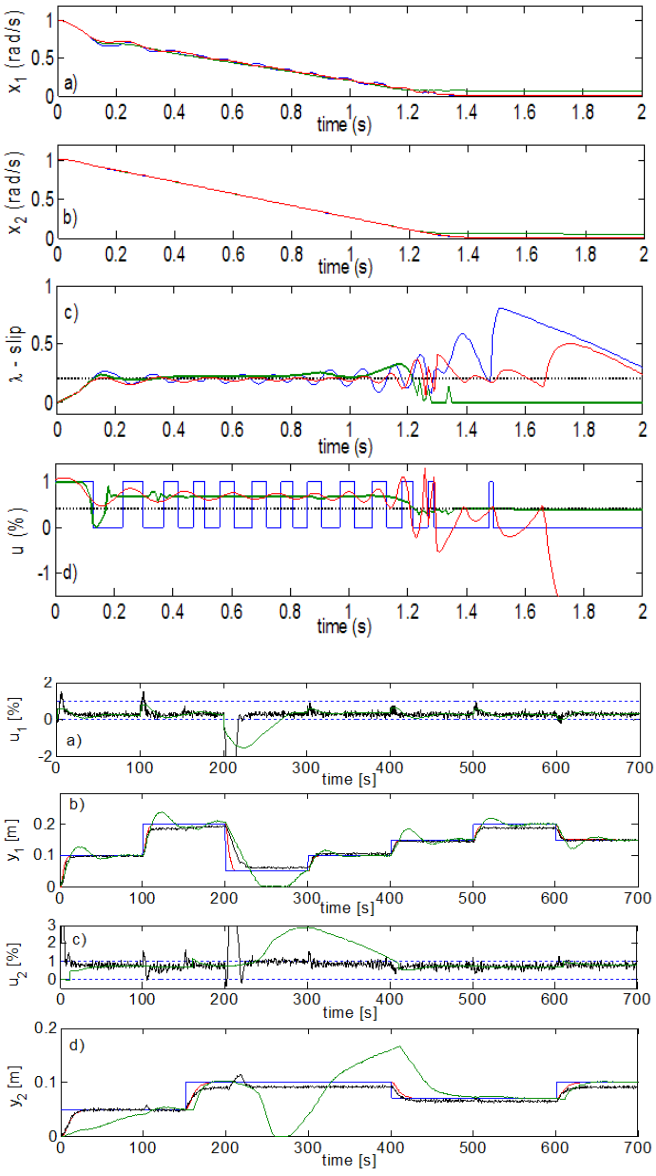

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TIME AND ENERGY EFFICIENT FRAMEWORK FOR INTER-OPERATION OF SMART DEVICES (TEEFIOS)

Goal of the project

Development of an integrated real-time and energy efficient inter-operation framework for networks of smart sensors and devices - TEEFIOS.

Short description of the project

- Wireless networks of sensors and smart devices (WSN) are an extremely interesting topic, at the confluence of engineering fields with enormous impact on worldwide society: digital networks, wireless communications, and miniature embedded digital devices.
- Aware of the severe requirements and challenges raised by current applications in this area, we propose a new paradigm - Time and Energy Efficiency (T: or TEE).

The main proposed objectives focus on three distinct layers:

- (a) T:Node, a hardware-software environment and methodology for designing and assessing real-time behavior and efficient energy consumption of embedded devices,
- (b) T:YNet, a system for the development and analysis of TEE communication in wireless ad-hoc networks, and
- (c) T:PIlot, a methodology for the power management of the entire network. An integrated set of tools, benchmarks and databases will also be created to help advanced developers and researchers in the WSN area apply the TEE paradigm to applications with high impact.

Project implemented by

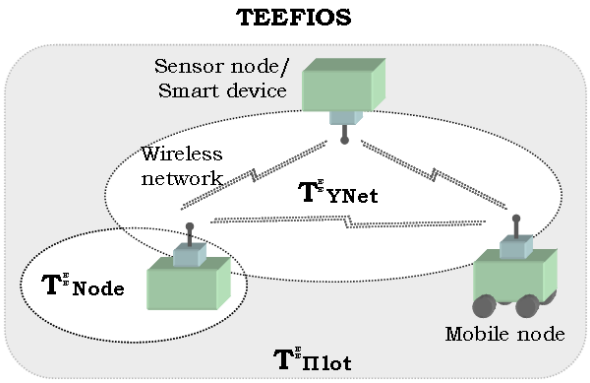
- DSPLabs - Digital Signal Laboratories Timisoara, Department of Computer and Software Engineering, Politehnica University of Timisoara.

Implementation period

01.10.2015 - 30.09.2017 (24 months)

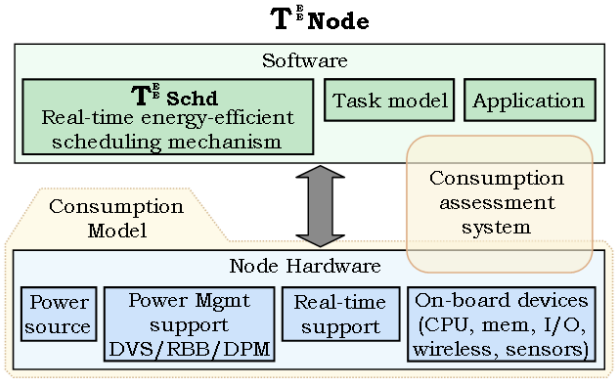
Grant value

548850 RON (~123337 EUR)



Main activities

- Energy consumption model and taxonomy for smart devices;
- Energy optimization real-time scheduling mechanism for smart devices;
- Methodology for node-level energy consumption assessment;
- Real-Time MAC protocol for ad-hoc wireless networks;
- Flexible real-time wireless module for smart devices;
- Framework for real-time communication in WSNs;
- Global power management methodology for networks of smart devices;
- Case studies to validate the TEEFIOS framework;
- Integrated set of databases and web-based tools;
- Information exchange, results dissemination and publication.



Results

- Integrated set of consumption models for smart devices;
- T:Schd, a real-time scheduling technique which optimizes energy consumption;
- Hardware/software methodology for the consumption evaluation of smart devices;
- Database with the energy efficiency evaluation and classification results for different types of smart devices;
- Real-time MAC protocol for ad-hoc wireless networks;
- Functional prototype of a flexible real-time wireless module for smart devices;
- A framework and a set of metrics for the evaluation of real-time wireless communication applications;
- A simulation testbed to evaluate the scalability of time and energy efficient WSN applications;
- T:Πlot, a global power management methodology for networks of smart devices;
- A collection of case studies that demonstrate the validity of the proposed framework and its individual components;
- An integrated set of web and database tools for public-level information and access to the TEEFIOS framework services.

Applicability and transferability of the results

- The real-time and energy efficient interoperation framework, along with the associated tool set and databases, will be of valuable use to the advanced developers and researchers in the field of wireless sensor/smart device networks.
- The results of this project will help them apply the TEE paradigm to applications with high impact in scientific, social, economic and environmental areas, such as: disaster recovery, smart buildings and structures, environment monitoring, smart energy grids and metering, robotic collectives, industrial process control, smart vehicles and transportation, security and surveillance.

Fields of interest

- Real-time systems;
- Energy efficiency;
- Sensors and smart devices;
- Wireless communication;
- Ad-hoc networks.

Financed through/by

UEFISCDI, Romanian Ministry of Education and Research, Bucharest, Romania.

Research team

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R&D team:
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INTERNET OF THINGS MEETS COMPLEX NETWORKS FOR EARLY PREDICTION AND MANAGEMENT OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Goal of the project

To address the problem of COPD (Chronic Obstructive Pulmonary Disease) management in a big population of individuals, using a personalized medicine approach that relies on big data gathering and modeling, according to the complex network paradigm. Our scope is to demonstrate a solution that consists of a mobile and cloud computing integrated system for COPD early detection, monitoring, and management.

Short description of the project

COPD is defined as the irreversible clinical condition which reduces pulmonary capacity; if diagnosed in an early phase, its evolution can be controlled. Unfortunately, the early detection of COPD is a difficult task. Capitalizing on recent research results which indicate the Internet of Things solutions as useful in monitoring and managing respiratory disorders, we propose a prototype system for early detection and evolution prediction of COPD. As such, we build a sensor network that gathers multiple physiological signals, and a mobile application that extracts the multi-fractal spectra as signal signatures. Then, the mobile system integrates the physiologic signatures with individual clinical data. On the server side, we collect the integrated data from a population of individuals, to build a complex network model of patients. To this end, we employ modularity clustering and network layout tools to build prediction models for both early detection and evolution prediction of COPD. The prediction model is instantiated as a smartphone application and tested to assess its predictive capacity.

Project implemented by

The research group lead by Mihai Udrescu and affiliated to Advanced Computing Systems and Architectures Lab, Politehnica University of Timișoara, and the Pulmonology Research Group from "Victor Babeș" University of Medicine and Pharmacy lead by Ștefan Mihăicuță.

Implementation period

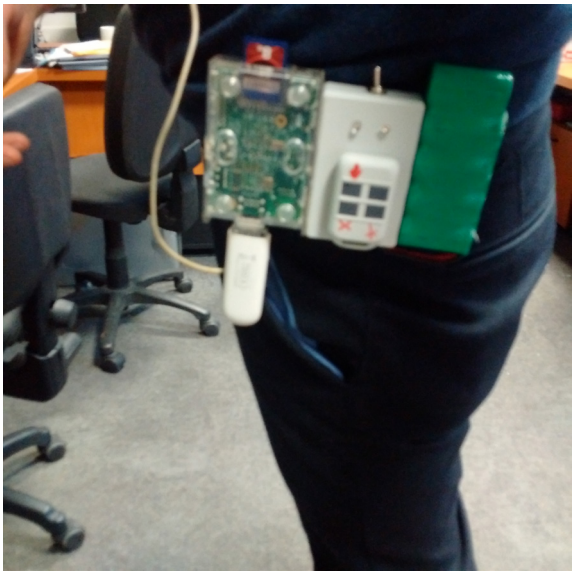
3.01.2017 – 30.06.2018

Main activities

Designing and implementing the mobile software that records anthropometric and clinical data, building a prototype sensor network for collecting physiological signals, implementing the software for multifractal analysis of gathered physiological signals, finding correlations between parameters and data using a complex network model, implementing a software COPD-stage predictor based on the physiological signals.

Results

1. Methodology for processing medical data based on complex network analysis, which allows for identification of clinically-relevant patient phenotypes. The proposed methodology is published in: Mihaicuta, S., Udrescu, M., Topirceanu, A., & Udrescu, L. (2017). Network science meets respiratory medicine for OSAS phenotyping and severity prediction. PeerJ, 5, e3289.
2. Experimental hardware/software platform for gathering and integrating anthropometric, clinical data with physiological signals from COPD patients.



Research centre

Research Center in Computing and Information Technology (CCCTI)

Research team

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Stefan Mihaicuta,
Daniela Reisz,
Rodica Dan,
Carmen Ardelean.

Applicability and transferability of the results

Active diagnosis and monitoring systems using a wearable sensor network with application in monitoring respiratory disorders.

Financed through/by

CNCS/CCCDI-UEFISCDI, project number PN-III-P2-2.1-PED-2016-1145, within PNCDI III, contract no. 31PED/2017

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EXPERIMENTAL ASSESSMENT OF A SELF-ADAPTIVE INTELLIGENT TRANSPORTATION SYSTEM

Goal of the project

At present, all attempts to optimize traffic flow completely ignore the fact that traffic has a predominant social footprint and would therefore potentially benefit from using specific tools to better understand its dynamics and predict its patterns (and thus introduce intelligence).
We therefore aim towards designing a distributed, hierarchical, self-adaptive decision-making that would respond quickly to traffic changes based on optimization carried over communities and superior estimation of its patterns.

Short description of the project

Our systems will: provide local optimizations, allow traffic lights to be networked, and provide global optimizations of traffic flow using decentralized, distributed control.

Project implemented by

Politehnica University of Timisoara

Implementation period

Oct. 2017 – Dec. 2018

Main activities

- Collecting data for urban traffic flow by using semi-permanent sensors
- Modelling existing transport infrastructure with respect to measured traffic values
- Software implementation of algorithms described in Cristian Cosariu's PhD thesis
- Porting the bio-inspired algorithm corresponding to a single node to an embedded platform for implementation on a traffic controller
- Comparative simulation with a before-after analysis of the main quality indicators of the traffic
- High-level description for the architecture and communication framework for adjacent intersections
- Validation by simulation with special tools for the described protocol
- Extensive testing of the embedded platform under realistic operating conditions to achieve 1 year availability
- Participation to at least 2 international conferences

Results

- Development and online publication of the project's website
- Procurement of hardware and software required for the implementation of the project
- Technical documents with actual traffic values for road segments
- Architectural diagrams and specifications of proposed protocol with validation through simulation
- Source code and standard description of proposed methodology, available online on the project's website

Conference papers:

1. Gabriel Baban, Alexandru Iovanovici, Cristian Cosariu, Lucian Prodan.. Determination of the Critical Congestion Point in Urban Traffic Networks: A Case Study. 2017 IEEE 14th International Scientific Conference on Informatics, Poprad, Slovak Republic, November 14 - 16, 2017, doi 10.1109/informatics.2017.8327215.

2. Gabriel Baban, Alexandru Iovanovici, Cristian Cosariu, Lucian Prodan.. High Betweenness Nodes and Crowded Intersections: An Experimental Assessment by Means of Simulation. IEEE 12th International Symposium on Applied Computational Intelligence and Informatics (SACI 2018), May 17-19, 2018, Timisoara, Romania.

Applicability and transferability of the results

Our algorithm quickly reacts to traffic dynamics based on local heuristics. Real traffic situations simulated using the Vissim software showed a decrease in waiting times and queue lengths at local intersection level. The algorithm can be mapped efficiently onto embedded devices, current TRL-3 standing.
Our SIGS methodology recreates the road network by changing lane directions by using genetic algorithms and also has a current TRL-3 standing.
Intersections will exchange local traffic values and allow genetic algorithms to provide optimizations, which brings this at TRL-2. This will provide distributed, self-adaptive optimization of traffic.

Financed through/by

UEFISCDI PN-III-P2-2.1-PED-2016-1518, nr. 221PED/2017

Research centre

- Politehnica university of Timisoara, Faculty of Automation and Computing
- Research Center in Computer and Information Technology (CCCTI)
- Advanced Computing Systems and Architectures Laboratory

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PARKING ASSISTANCE SYSTEM FOR TPARK

Goal of the project

The objective of the "Parking Assistance System for TPark" project was to extend the services offered to the clients of Piconet company, which is the national leader of city surface parking management systems. The aim was to develop a robust method for monitoring the parking occupancy based on processing of images captured by surveillance cameras. This method has to adapt to harsh weather conditions and to changing in illumination due to some natural causes as clouds or artificial as night lighting.

Short description of the project

The project work result was a working prototype implementing the proposed method able to process the information provided by parking surveillance cameras. The method combines image processing algorithms with statistical information collected by the company, and with learned data.

Project implemented by

Universitatea Politehnica din Timisoara

Implementation period

25/07/2017 – 31/12/2017

Main activities

Activity 1. Developing a robust method to monitor the state of parking places in public car parks by processing information from surveillance cameras.
Activity 2. Implementing a prototype of the monitoring system to validate the method in a real use case on Timisoara Central parking.

Activity 3. Developing a method for estimating the time of parking space occupancy.
Activity 4. Extending the prototype of the monitoring system to allow validation of it.
Activity 5. Developing and documenting a methodology for installing and configuring the prototype of the monitoring system.

Results

- A method to monitor the status of parking occupancy for a surface parking lot.
- A prototype to validate the method implemented in C++ using the OpenCV open source library.
- A method for estimating the time of parking space occupancy.
- An extension of the first prototype in order to validate this method.
- Research report describing the proposed approach and a Web page to document the project and the obtained results.

Applicability and transferability of the results

The results will be used to extend the services offered by Piconet company for its clients represented by the drivers searching for a public parking space. It will be integrated in the company monitoring system and will be offered to new clients interested in extended services. The company also planned to implement a mobile application capable to offer online information on free parking places based on this monitoring system.

Financed through/by

Budget: Unitatea Executiva pentru Finantarea Invatamantului Superior, a Cercetarii, Dezvoltarii si Inovarii (UEFISCDI) - Directia de Finantare a Dezvoltarii si Inovarii
Co-financing: S.C. Piconet SRL

Research centre

Research Center in Computers and Information Technology (CCCTI), UPT

Research team

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DEVELOPMENT OF URBAN GREEN SPACE MONITORING TECHNIQUE WITH REMOTE SENSING AND ITS APPLICATION

Goal of the project

City is the important area of earth's surface material, energy, and information exchanging; also it is the center in national, regional political, economic, scientific and cultural aspects. Remote sensing imagery enables rapid and efficient quantification urban eco-environment and it gives a new insight for urban environmental research. A wide range of urban remote sensing applications is available.
With the availability of super high resolution remotely sensed imageries and multi-source remote sensing data, there is a great need to transform remote sensing data into useful information that we need for urban studies. High resolution remote sensing data make a clear potential to help humans to make a better understanding of their living places, to measure the biophysical parameters of urban vegetation, to model the environmental process in urban areas, to map the urban features quickly, to update the urban land covers, etc.

Short description of the project

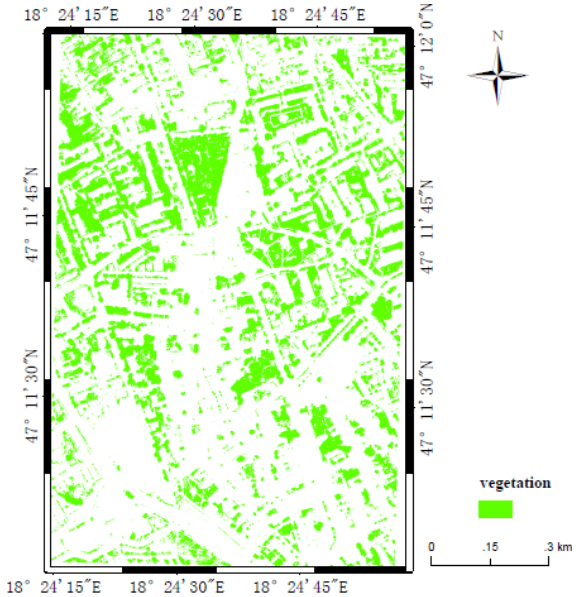
In the scientific literature, there are studies on the urban green space monitoring based on modeling the proximity of buildings to green space with remote sensing using multi-source satellite images. The study achievement would provide reference for the measurements of green space, serve the urban eco-environment quality monitoring. At the same time, it was of great theory and practical significance to improve utility efficiency of satellite data and eco-environment monitoring precision. The project would build up stable demonstration for scientific and technology cooperation and exchanging between Romania and China, and make cooperation deeper and more durative.

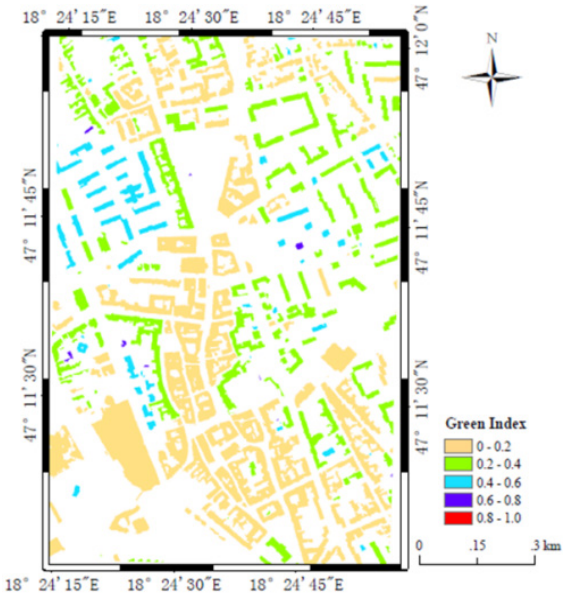
Project implemented by

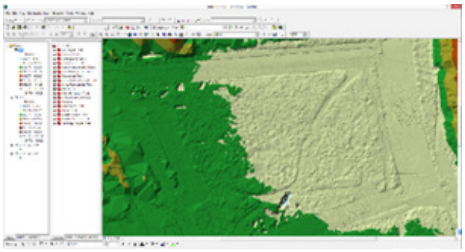
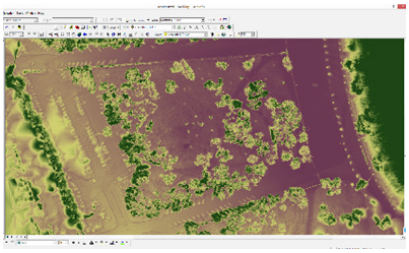
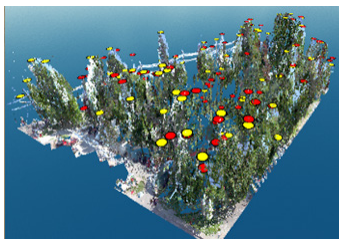
- Chinese Academy of Science, Institute of Remote Sensing and Digital Earth, Prof. Meng Quinyan
- Politehnica University of Timisoara, Faculty of Civil Engineering, Assoc. Prof Sorin Herban

Implementation period

October 2016 – December 2017





Main activities

- Techniques for multi-source remotely sensed data fusion;
- Development of new classification algorithms for urban mapping using high resolution remotely sensed data;
- 3D modeling of urban features based on high resolution remotely sensed data;
- Development of an urban green space evaluation model;
- Studying the urban green space parameters quantitative retrieval technology;
- Generation of the Normalized Height Model (NHM);
- Collection of LiDAR data on urban areas;
- Collection of DEM (Digital Elevation Model) on urban areas;
- Generation of DSM (Digital Surface Model) from LiDAR data;
- Generation of the Normalized Height Model by subtracting the DEM from the DSM;
- Image segmentation algorithms;
- Design of a robust segmentation algorithm for urban feature segmentation;
- Segmentation accuracy assessment;
- Extraction of Urban Buildings;
- Building mapping;
- Generation of Building Height model;
- 3D modeling of urban trees using LiDAR;
- Urban green mapping;
- Tree detection and the 3D modeling of the urban trees;
- Urban green mapping using Multi-spectral images;
- Machine learning techniques for classification of urban green;
- Shadow detection and removal;
- Accuracy assessment.

Results

Develop an evaluating system for measuring the quality of the urban environment using remote sensing technology.
Probe the relations between green space and other environmental elements based on the space-time multi-scale urban green space model.
Demonstrate the urban green space monitoring technology among different cities.

Applicability and transferability of the results

The project is expected to exchange the GIS & RS technologies in evaluating urban eco-environment of both countries to validate that the established urban eco-environmental model can be suitable for both countries.
The expected results will provide the local governments with the change direction of local urban ecological environment, and be benefit for the environmental management or policies. It will help the sustainable urban development works.

Financed through/by

Unitatea Executivă pentru Finanțarea Învățământului Superior, a Cercetării, Dezvoltării şi Inovării UEFISCDI

Research Centre

Infrastructures for Constructions and Transportation (ICT)

Research team

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NOVEL NANOMATERIALS BASED STRATEGIES FOR INNOVATIVE SENSING SYSTEMS APPLIED IN SAFETY AND QUALITY CONTROL OF NATURAL JUICE

Goal of the project

The main goal of the project is to contribute greatly exploratory research in developing new electrode materials with advanced properties linked to the original exploitation of certain electroanalytical techniques envisaging smart strategies for food quality control and safety.

Short description of the project

This research proposal envisage an important contribution to food quality control and safety through elaboration of new strategies for qualitative and quantitative evaluation of the potentially harmful compounds (residues of pesticides and preservatives) from natural juices, by involving well-controlled nanomaterials in the development of innovative detection systems with improved electroanalytical performances. Detection systems will be based on new glassy carbon sensors modified with carbon nanostructuresand metallic nanoparticles that will allow the elaboration of selective/ simultaneous detection protocols for preservatives and pesticides, potentially present in juices. Sensor surface modification with membrane will permit selective access of target analytes only to carbon nanostructures, allowing a specific concentration on the electrode surface.

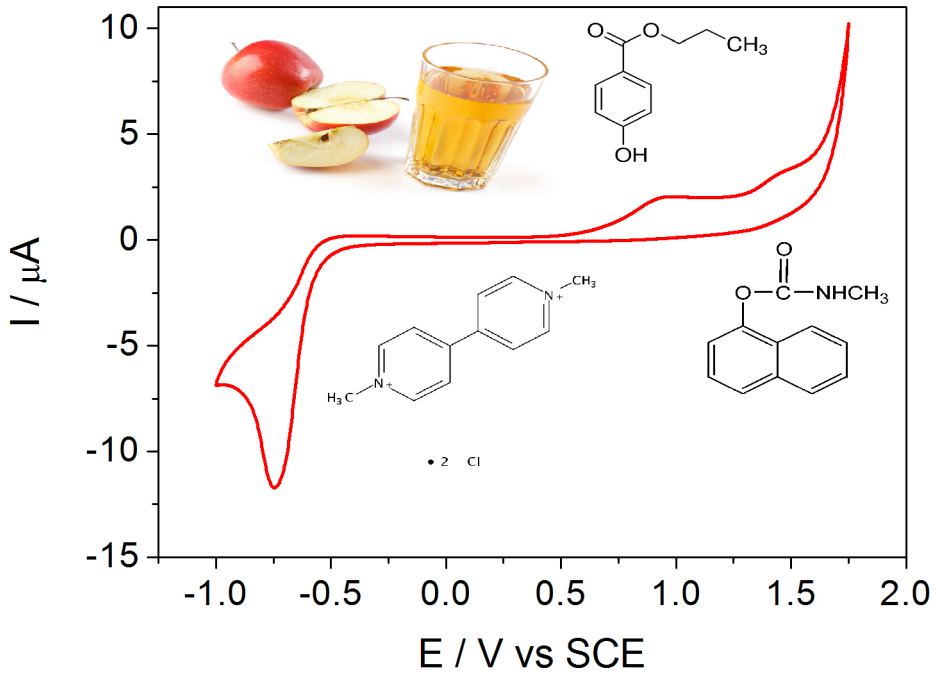
Expected performance of detection strategies proposed by project open the perspective of practical applications in the direction of their use by regulatory bodies for food quality control or even by natural juices producers, either before processing of the potentially contaminated fruits with pesticide residues, either on the production flow or final product quality evaluation/monitoring.

Project implemented by

Faculty of Industrial Chemistry and Environmental Engineering

Implementation period

01.10.2015 - 30.09.2017



Main activities

i. Obtaining new sensors based on nanostructured carbon by modifying classic glassy carbon (GC) electrode with CNT/CNF/ graphene/fullerene characterized by structural, morphological and electrochemical specific properties suitable for electrochemical detection applications.
ii. Sensors functionalization with metallic nanoparticles (Cu/Ag/Au/ Pt) by advanced electrochemical (multiple-pulsed amperometry – MPA, chronoamperometry – CA and cyclic voltammetry - CV) with morpho-structural and electrochemical properties characteristic to the electrochemical detection applications.
iii. Elaboration of procedure/detection schemes for target analytes from preservatives and pesticide residues categories based on obtained new sensors and their optimization.
iv. Development of detection techniques with intermediate preconcentration step on electrode surface for harmful compounds at trace levels from test sample, exploiting adsorbent properties of nanostructures carbon.
v. Elaboration of simultaneous and/or selective detection procedures/ schemes of selected target analytes, by sensors modification with selective membranes.
vi. Procedures checking through detection strategies elaboration for specific applications in juices quality control and safety.

Results

- New sensors modified with nanostructured carbon (carbon nanotubes (CNT), carbon nanofibers (CNF), fullerenes and graphene) and/or metallic nanoparticles (Cu / Ag / Au / Pt) for natural juices safety and quality control applications.
- Protocols for selective/ simultaneously detection of preservatives and pesticides potentially present in natural juices.

Applicability and transferability of the results

New sensors modified with nanostructured carbon (carbon nanotubes (CNT), carbon nanofibers (CNF), fullerenes and graphene) and/or metallic nanoparticles (Cu / Ag / Au / Pt) for natural juices safety and quality control applications.
Protocols for selective/ simultaneously detection of preservatives and pesticides potentially present in natural juices.

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation - UEFISCDI

Research centre

Research Institute for Renewable Energy – ICER TM
Research Centre in Environmental Science&Engineering

Research team

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DEVELOPMENT OF NANOSTRUCTURED MAGNETIC COMPOSITES USED AS NANO-ADSORBENTS AND NANO-CATALYSTS WITH HIGH PERFORMANCE IN ENVIRONMENTAL APPLICATIONS

Goal of the project:

Developing new efficient synthesis variants of oxide nanoparticles in order to obtain nanomaterials, magnetic nanostructures based on iron oxides (gamma-Fe_2O_3, Fe_3O_4, ferrites spinels MFe_2O_4) with tailored properties for their use as nano-adsorbents and nano-catalysts for remediation of water.

Short description of the project:

Water pollution by heavy metals and organics has become a serious problem because of their extremely hazardous effects on humans and the ecological systems.

The present project is focused on the developing of nanostructured magnetic materials based on iron oxides (magnetite, maghemite, spinel ferrites) with special properties (magnetic properties, specific surface area and morphology) that can be used as high performance nano-adsorbents and nano-catalyst for the removal of inorganic (metals ions: Cd(II), Pb(II), Cr(VI), Cu(II), Co(II), Zn(II)) and organic (dyes and phenols) pollutants from wastewaters. In order to achieve this we will develop new, original versions of the two unconventional synthesis methods of nanopowders and nanocomposites: solvothermal method and thermal decomposition of precursors. In order to develop high performance nanostructured magnetic oxides (iron oxides and ferrites) with high specific surface area, porosity and adequate magnetic properties composites like magnetic oxides/carbon will be synthesized by these methods, using different common carbon precursors in order to obtain low cost final materials. Also, the functionalization of surface will be performed with different organic modifiers in order to make the nanoparticles specific for certain applications.

Finally, the obtained iron oxides based magnetic nanostructures materials (oxides, ferrites and composites) will be tested as nanoadsorbants and catalyst for the removal of water pollutants.

Project implemented by

University Politehnica Timisoara

Implementation period:

01.10.2015-30.09.2017

Main activities:

I. Synthesis of magnetic oxide nanopowders (Fe_xO_y, MFe_2O_4) by new, original variants of solvothermal method and of thermal decomposition of the precursors and powders characterization.

A.I.1 Study of the influence of organic solvents' nature on the structure and morphology of the oxide particles obtained by solvothermal method. Determination of the most appropriate solvent for the synthesis of a series of solvents which have not been reported in the literature.

A.I.2 Study of the influence of polyols nature and polyol: metal nitrates ratio and of the presence of surfactants on the structure, morphology, magnetic properties of nanopowders synthesized by the method of decomposition of precursors.

A.I.3 Characterization of materials obtained by thermal analysis, FT-IR spectroscopy, X-ray diffractometry, specific surface area and porosity measurements, Mosbauer spectroscopy, X-ray diffractometry, SEM, TEM electron microscopy, magnetic measurements.

A.I.4 Writing scientific report and disseminate the results through participation in an international conference. Making the project web page

II. Synthesis of the nanocomposites type Fe_xO_y / C and MFe_2O_4 / C by original synthesis methods and their characterization

A.II.1 Study of the influence of process parameters: temperature and autoclaving time on the structure, morphology and properties of synthesized nanocomposites

A.II.2 Study of the influence of organic solvents' nature on the structure and morphology of the oxide particles obtained by solvothermal method. Determination of the most appropriate solvent for the synthesis of a series of solvents which have not been reported in the literature

A.II.3 Study of the influence of initial oxide precursor: carbon precursor ratio on the carbon content of the composite.

A.II.4 Study of the influence of carbon precursor nature on the carbon content of composites with carbon and their morphology

A.II.5. The obtaining of composites by thermal decomposition of precursor method: influence of decomposition atmosphere, calcination temperature and time and of the presence of other carbon precursors in addition beside the polyol used as a reductant.

A.II.6 Characterization of the obtained nanocomposites by thermal analysis, FT-IR, X-ray diffractometry, the specific surface area and porosity measurements, Mössbauer spectroscopy, X-ray diffractometry, electron microscopy, SEM, TEM, magnetic measurements.

A.II.6 Writing scientific report and disseminate the results through participation in an international conference and publication of an ISI

article.
III. Testing of magnetic powders synthesized as adsorbent materials and catalysts for removal of inorganic and organic pollutants in water
A.III.1 Testing of oxide nanopowders Fe_3O_4, Fe_2O_3, MFe_2O_4 compared to the corresponding nanocomposite Fe_3O_4 /C, Fe_2O_3 /C, MFe_2O_4 /C as a metal ion adsorbents: Cd (II), Cr (VI), Pb (II), Cu (II), Ni (II), Co (II
A.III.2 Testing of oxide nanopowders Fe_3O_4, Fe_2O_3, MFe_2O_4 compared to the corresponding nanocomposites Fe_3O_4 /C, Fe_2O_3 /C, MFe_2O_4 /C as adsorbents for organic contaminants: colorants and phenolic compounds.
A.III.3 Testing of functionalized oxide powders as adsorbents for inorganic and organic pollutants studied. Study on the influence of nature of surface functional groups on pollutant removal efficiency
A.III.4 Testing of Fe_xO_y and MFe_2O_4 magnetic powders as catalysts for catalytic oxidative degradation of organic pollutants: dyes and phenolic compounds
A.III.5 Study the possibility of regeneration of the adsorbent material by controlled desorption of adsorbed species in different solvents or by changing the pH.
A.III.6 Study of adsorbent material reuse on its performance (maximum capacity of adsorption of pollutant removal efficiency). Proposing a technological schemes for use in remediation of water nanopowders
A.III.7 Preparing final scientific report. Dissemination of results: patent proposal preparation and submission and publication of 2 ISI papers..

Results:

Published papers:
1. Stoia M., Istratie R., Pacurariu C., Investigation of magnetite nanoparticles stability in air by thermal analysis and FTIR spectroscopy, Journal of Thermal Analysis and Calorimetry (2016) 125, 1185–1198
2. Stoia M., Pacurariu C., Istratie R., Barvinschi P, Locovei C., Thermoanalytical techniques: Excellent tools for the characterization of ferrite/SiO2 nanocomposites and their precursors, Journal of Thermal Analysis and Calorimetry (2016) 125, 1249–1263,
3. Stoia M., Pacurariu C., Muntean E.C., Thermal stability of the solvothermal-synthesized MnFe2O4 nanopowder, Journal of Thermal Analysis and Calorimetry,

Conferences
1. Cornelia Muntean: The XXXVIII National Congress on Calorimetry, Thermal Analysis and Applied Thermodynamics (AICAT-GICAT 2016) Ischia (Naples), Italy, September 25-28, 2016
Cornelia Muntean, Marcela Stoia, Geza Bandur: Thermal evolution OF MnFe2O4 precursors obtained by co-precipitation in organic medium
2. Eliza Muntean: 25-th Symposium on Thermal Analysis and Calorimetri - Eugen Segal, Bucuresti, Romania, Ferbuarie, 2016
Stoia M, Muntean Eliza, Pacurariu C, Study on thermal evolution of MnFe2O4 /C composites synthesized by solvothermal method
3. Muntean Eliza: "New trends and strategies in the chemistry of advanced materials with relevance in biological systems, technique and environmental protection" 9th Edition, June 09-10, 2016
Muntean E., Stoia M., Pacurariu C. Solvothermal synthesis of manganese ferrite nanopowders using different surfactants

Applicability and transferability of the results:

This project will develop innovative and original solutions, both in terms of getting nanomaterials used as nano-adsorbents or nanocatalysts in wastewater treatment processes and in terms of regeneration of adsorbents / catalysts and their reintroduction in the process of treatment the waste water, so as to minimize the impact on the environment.
The project aims to find effective solutions as easy to achieve as practical and cheap for treatment of effluents loaded with ions of heavy metals and organic pollutants (dyes and phenols) using as adsorbents the magnetic oxide nanopowders to be obtained.

Financed through/by

Executive Agency for Higher Education Research, Development and Innovation Funding (UEFISCDI)

Research Center

Research Institute for Renewable Energy , University Politehnica Timisoara

Research team

Project leader: Lecturer eng. Stoia Marcela Elena, PhD
Senior researcher: Lecturer eng. Muntean Cornelia Veronica, PhD
Postdoctoral researcher: Lecturer. eng. Lupa Lavinia, PhD
Postdoctoral researcher : Assist. eng. Moaca Alina, PhD
PhD student: eng. Muntean Eliza
PhD student: eng. Gabor Andreea

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SOLAR LIGHT- ACTIVATED NANO-TIO2 DOPED WITH SILVER-COVERED ACTIVATED CARBON AND ZEOLITE BASED PHOTOCATALYTICALLY-ASSISTED FILTERING SYSTEM FOR WATER TREATMENT (WATICAZ)

Goal of the project:

The WATICAZ project scope is to develop an innovative water treatment unit characterized by enhanced performance consisted of the photocatalysis-assisted filtering system (PFS) as experimental demonstrator at laboratory scale for the treatment of real drinking water source. This system should exhibit the bifunctional adsorptive and photocatalytic characteristics that can be exploited either as filtering system with the possibility of solar photocatalytic regeneration (SPR) or as advanced oxidation unit to remove/degrade a large range of contaminants from water.

Short description of the project

The photocatalytic-assisted filtering unit using (doped)TiO_2-covered activated carbon/zeolite operated under UV/solar irradiation is developed.

Project implemented by

Partnership between Politehnica University of Timisoara and National Institute for Research and Development for Electrochemistry and Condensed Matter

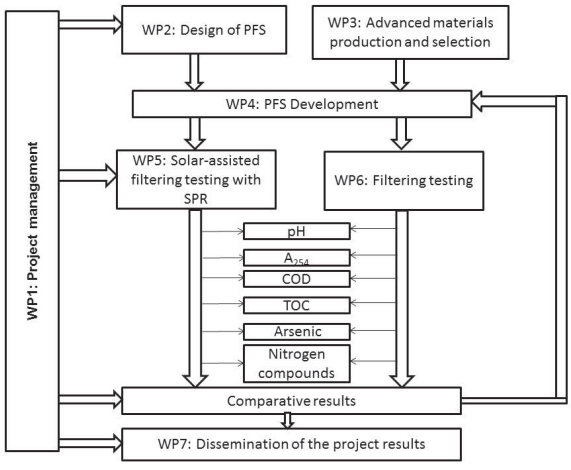
Implementation period

03.01.2017-29.06.2018

The main work packages and tasks are:

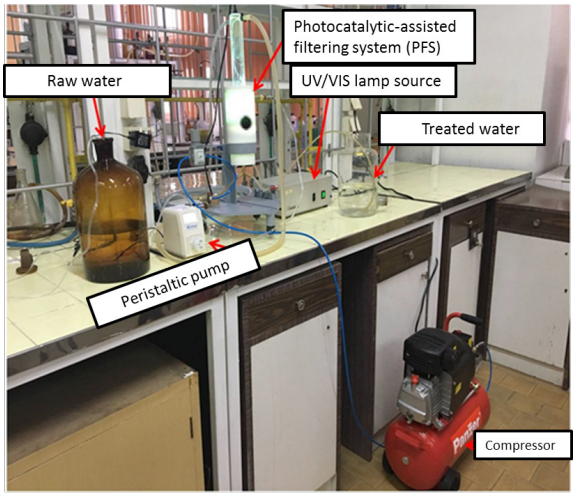
- Project management;
- Design of photocatalysis-assisted filtering system (PFS);
- Filtering materials production and selection *(Synthesis of the filtering materials characterized by the photocatalysis activity; Characterization of filtering materials by XRD, SEM, AFM, BET, DRUV-VIS)*;
- (Solar-assisted) filtering testing (with solar photocatalytic regeneration - SPR) *(Filtering column filling; Functional and operational testing of (solar irradiation photocatalysis-assisted) filtering system; Filtering material regeneration under solar irradiation; Morpho-structural characterization of materials after its usage; Validation by testing for the treatment of the real drinking water source)*;
- Dissemination of the results.

Main activities

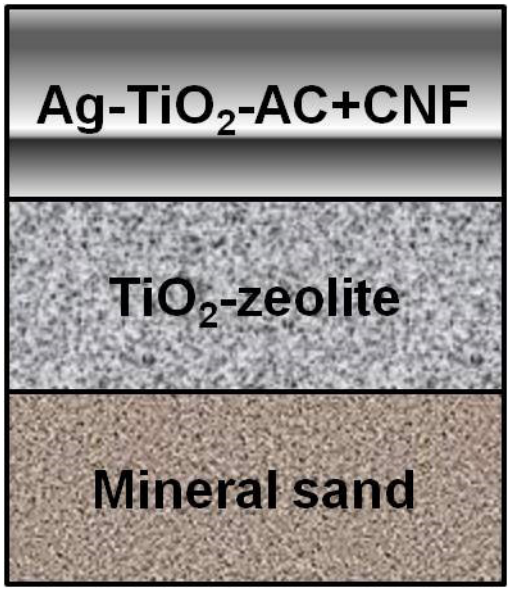


Project flow chart with work packages (WPs)

Results



Photocatalysis-assisted filtering unit



Layers of materials in filtering column

Applicability and transferability of the results

Drinking water and wastewater treatment plants

Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)

Research Center

Research Center of Environmental Science and Engineering

Research team

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Lecturer dr.eng. Andra Tamas
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ADVANCED MATERIALS BASED ON COMBUSTION-SYNTHESIZED MAGNETIC IRON OXIDES NANOPARTICLES AND THEIR CYTOTOXICITY DESIGNED FOR CANCER TREATMENT

Goal of the project:

- Obtaining of magnetic iron oxides nanoparticles using the combustion synthesis method and monitoring the influence of several working parameters: fuel type (EDTA, citric acid, glucose), oxidant/fuel molar ratio (fuel-rich compositions), ignition procedure (heating mantle, microwave field), working atmosphere (in air/no air), carbon and organic residues presence.
- Preparation of colloidal suspensions.
- The assessment of the toxicological profile/biological activity of the iron oxide colloidal suspensions on normal/tumour liver and kidney cell lines.

Short description of the project

The project presents the preparation of iron oxides with via combustion synthesis and testing their selective cytotoxicity.

Project implemented by

Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment,
Faculty of Industrial Chemistry and Environmental Engineering, Politehnica University Timisoara

Implementation period

July 2017-December 2019

Main activities

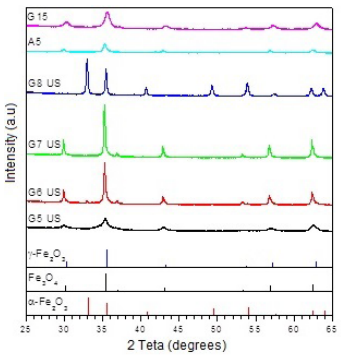
Combustion synthesis of magnetic iron oxides nanoparticles.
The influence of several parameters on the powders characteristics were pursued:

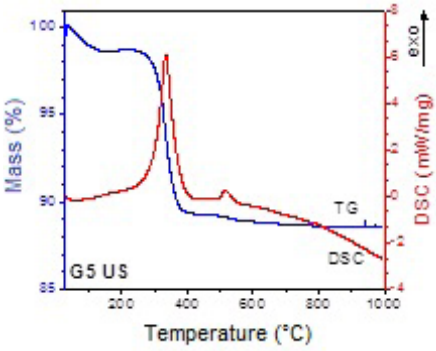
- nature of the fuel: glucose, citric acid, EDTA, TWEEN 80, hexamethylenetetramine
- reaction conditions: presence and absence of air
- carbon and organic residues presence and chemical oxidation removal using H_2O_2

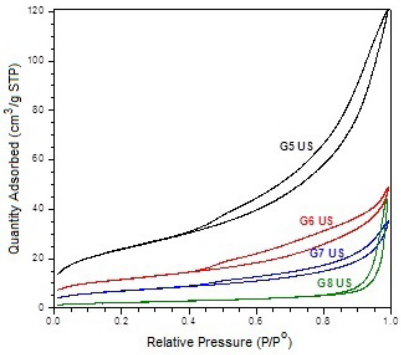
Characterization of magnetic iron oxides nanoparticles:

- combustion reactions evolution was assessed by TG-DSC thermal investigations
- the phase composition of the synthesized compounds was investigated by XRD
- specific surface area (BET)
- FTIR spectroscopy

The obtained results were centralized and interpreted for recipes optimization.







Results:

Synthesis protocols and recipes for 31 samples prepared by combustion synthesis. It was established the influence of different fuels (glucose, citric acid, EDTA, TWEEN 80, hexamethylenetetramine) and of the reaction conditions on the synthesis of iron oxides with magnetic properties.

Applicability and transferability of the results

These researches open an entirely new perspective on the potential use of combustion-synthesized iron oxide nanoparticles in cancer therapy by selective cytotoxicity.
The results will be subjected to a patent application.

Financed through/by

Ministery of Research and Innovation, CNCS - UEFISCDI,
project number
PN-III-P4-ID-PCE-2016-0765, within PNCDI III

Research Center

Research Centre for Inorganic Materials and Alternative Energies

Research team

1. Cornelia Pacurariu - project leader
2. Cristina Dehelean - experienced researcher
3. Robert Ianos - experienced researcher
4. Radu Lazau - experienced researcher
5. Dorina Coricovac - postdoc researcher
6. Alina Moaca - postdoc researcher
7. Roxana Babuta (Racoviceanu) - postdoc researcher
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BIOCATALYST- CLICK CHEMISTRY DOWNSTREAMING TANDEM BASED INNOVATIVE KIT FOR OPTICALLY PURE FINE CHEMICALS SYNTHESIS

Goal of the project:

Development of an innovative kit for efficient and cost-effective sequential continuous flow large-scale (multigram) preparation of optically pure chiral building blocks useful for synthesis of pharmaceutical compounds and agricultural chemicals, based on the tailor-made immobilized lipases mediated kinetic resolution of various racemic substrates and a subsequent click chemistry-type downstreaming of the reaction mixture.

Short description of the project

A chemo-enzymatic process which integrates several innovative steps in both biocatalytic and down streaming parts was set up. The use of an immobilized biocatalysts-click chemistry tandem allowed to design easily scaled-up continuous flow procedures for industrial manufacturing of the target compounds.

Project implemented by

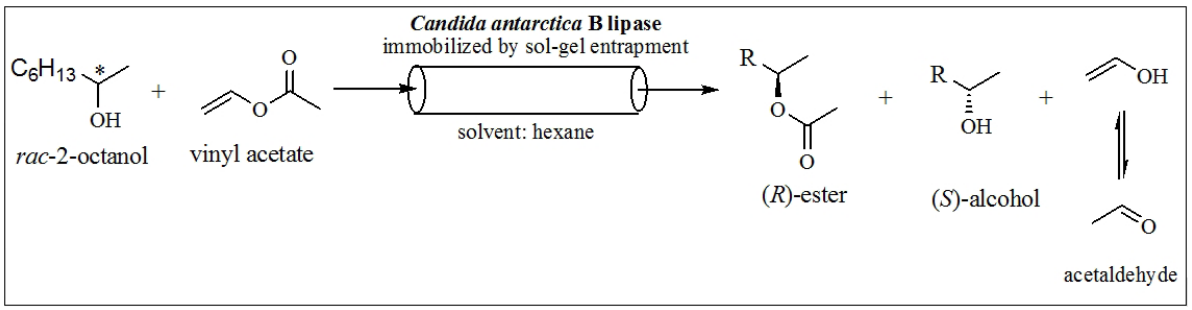
- University Politehnica Timişoara - Project leader
- University "Babes-Bolyai" Cluj Napoca - Project Partner 1
- Natural Ingredients R&D S.R.L - Project Partner 2

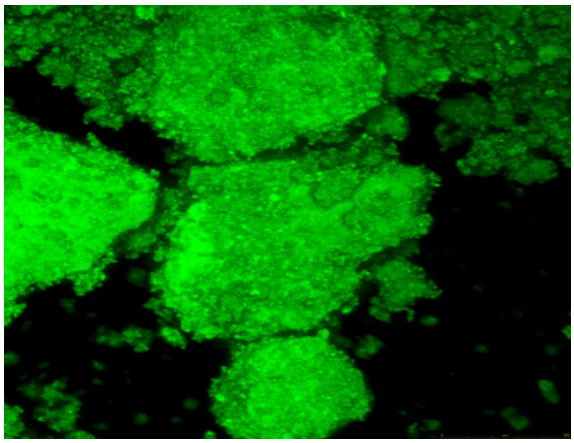
Implementation period

01.07.2014 - 30.09.2017

Main activities

1. Synthesis of various precursors: (hetero)aryl-ethanols, amines, hydroxy- and amino acids, as well as various propargylic esters as O- and N-acylating agents for enzymatic kinetic resolution (EKR).
2. Development of optimal EKR and click-chemistry type down streaming procedures.
3. Immobilization of lipases.
4. Development of the continuous flow procedure, on model substrates and newly synthesized substrates.





Fluorescence image of the sol-gel immobilized lipase

Results

Racemic compounds holding a secondary OH group were subjected to lipase mediated kinetic resolution in the presence of an ester having a terminal ethynyl group. Click methodology was used to separate the enzymatic acylation reaction products, also at preparative scale, under the optimal reaction conditions identified on the analytical scale. Heteroaromatic compounds were synthesized with high optical purity (93-99%) and yields between 90-95%. The effectiveness of sol-gel immobilized enzyme preparations in enzymatic kinetic resolution reactions was tested in a continuous system for both aliphatic and aromatic substrates. The reactions were optimized by factorial experimental programs using the Box-Behnken method.

For the enzymatic kinetic resolution of rac-2-chloromandelic acid lipase from *Candida antarctica* A proved to be the most active, immobilized by entrapment in sol-gel matrices based on ternary mixture of silanes combined with adsorption on Celite.
Please visit also: http://chim.upt.ro/ro/cercetare/proiecte-de-cercetare/145-pn-ii-pt-pcca-2013-4-0734
Selected publications in the field of the project:
1. A. Todea, P. Borza, A. Cimporescu, C. Paul, F. Peter, *Catalysis Today,* 2017, https://doi.org/10.1016/j.cattod.2017.02.042.
2. M. E. Moisă, C. G. Spelmezan, C. Paul, H. J. Bartha-Vári, L. C. Bencze, F. D. Irimie, C. Paizs, F. Péter, M. I. Toşa, *RSC Advances*, 2017, 7, 52977-52987.
3. A. Cimporescu, A. Todea, V. Badea, C. Paul, F. Peter, *Process Biochemistry*, 2016, 51(12), 2076-2083.
4. D. Aparaschivei, A. Todea, I. Păuşescu, V. Badea, M. Medeleanu, E. Şişu, M. Puiu, A. Chiriță-Emandi, F. Peter, *Pure and Applied Chemistry*, 2016, 88 (12), 1191-1201.
5. C. Paul, P. Borza, A. Marcu, G. Rusu, M. Bîrdeanu, S. Marc Zarcula, F. Peter, *Nanomaterials and Nanotechnology*, 2016, 6:0, doi: 10.5772/62194.8.

Applicability and transferability of the results

The application of tailor-made biocatalysts in industrial processes increases the economic benefits compared to the synthetic solutions. The productivity, stability, enantiomer selectivity and reusability of the enzymes increase by immobilization. The immobilized biocatalysts can be used in continuous bioreactors, under harsher conditions. The results will be scaled-up by the industrial partner, but they are available for all companies interested in fine synthesis of optically active compounds.

Financed through/by

Romanian Authority for Scientific Research and Innovation (UEFISCDI), Partnership - type project, project number PN-II-PT-PCCA-2013-4-0734 / 01.07.2014

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Research Centre in Organic, Macromolecular and Natural Compounds Chemistry and Engineering

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RECYCLABLE MULTILAYER MAGNETIC BIOCATALYST FOR SYNTHESIS OF NATURAL ESTERS

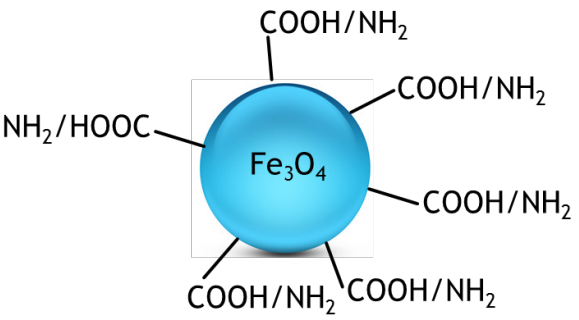
Goal of the project:

The main goal of the project is to develop a demonstration model for a new biocatalyst containing a designed magnetic core and hybrid layers (organic and silica) that allow the immobilization of enzymes. The validation of the model will be accomplished through the effectiveness of the product in a specific reaction, to demonstrate that such a biocatalyst is stable, reproducible, recyclable and able to synthesize esters that are accepted as naturals according to the EC regulations (Regulation no 1334/2008 of the European Parliament and subsequent amendments).

Short description of the project

The key objective is a comprehensive evaluation of the magnetic manipulation efficiency of enzyme functionalized magnetic nanocomposites obtained by applying cost-effective preparation procedures and manifold advanced characterization and testing techniques. The chemical composition, structure, size distribution, magneto- responsiveness and size, as well as the enzyme loading capability will be designed to fulfill the requirements for efficient biocatalysis and easy recovery of the enzyme even from viscous media, avoiding the contamination of the product and allowing its recognition as "food-grade".

An innovative multilayer technology will accomplish the demonstrative model. The immobilization of lipase on controlled-size magnetic core nanoparticles will be combined with stabilization of the hybrid composite through a sol-gel silica shell. The size and magnetic properties of the core particles will be adjusted to allow the optimal catalytic efficiency.



Project implemented by

- University Politehnica Timişoara-Project leader
- National Institute for Research and Development of Isotopic and Molecular Technologies INCDTIM Cluj-Napoca - Project partner

Implementation period

30.01.2017- 29.06.2018

Main activities

The objective of the project is to develop a demonstration model for a new biocatalyst containing a designed magnetic core and hybrid layers (organic and silicon) that allow the immobilization of enzymes, as well as the validation of the model through its effectiveness in a specific reaction of aroma ester synthesis.

Stage 1 (2017, 12 months) – Development of a new multilayer magnetic biocatalyst

Stage 2 (2017, 12 month) – Synthesis of natural esters in repeated cycles using the multilayer magnetic biocatalyst

Results

The research carried out in this stage was focused on:

- development of a new multilayer magnetic catalyst by preparation of various magnetic nanoparticles;
- immobilization studies of *Candida antarctica* B lipase on these supports;
- investigation of the resulted biocatalysts in esterification reactions.

Magnetic clusters functionalized with amino and carboxyl groups were obtained, and their structural, morphological and their magnetic characteristics were determined by instrumental methods, like as XPS spectroscopy. A second direction was the production of single-core magnetic nanoparticles stabilized by coating with various surfactants. These nanoparticles were thoroughly characterized by FT-IR, TEM, and XPS.

For both multi-core and single-core magnetic particles, the hydrodynamic diameters and zeta potential values have been also determined. The investigations concerning lipase immobilization included the influence of the nature and concentration of the binding agent (carbodiimide or glutaraldehyde), as well as finding of the optimal reaction conditions for covalent binding. The hydrolytic and esterification activities of the obtained biocatalysts were assayed on standard substrates.
Visit also: http://chim.upt.ro/ro/cercetare/proiecte-de-cercetare/247-pn-iii-p2-2-1-ped-2016-0168

Publications in the field of the project:

1. A. Nan, I. V. Ganea, R. Turcu, Physicochemical properties of a new magnetic nanostructure based on poly(benzofurane-co-arylacetic acid), *Analytical Letters*, accepted, DOI: 10.1080/00032719.2017.1400041
2. A. Todea, D. Aparaschivei, V. Badea, C.G. Boeriu, F. Peter, Biocatalytic route for the synthesis of oligoesters of hydroxy-fatty acids and ε-caprolactone *Biotechnology Journal*, 2018, accepted.

Presentations at conferences:

1. R. Turcu, C. Vasilescu, A. Nan, T. Radu, I. Crăciunescu, A. Petran, M. Cîrcu, A. Bunge, F. Peter, Magnetic nanostructures with functional coating specifically designed for immobilization of enzymes, *2nd World Congress & Expo on Materials Science and Nanoscience*, September 25-27, Valencia, Spain.
2. C. Vasilescu, I. Benea, C. Paul, A. Todea, R. Turcu, F. Peter, Immobilization of lipase from *Candida antarctica* B by covalent binding onto magnetic supports, *New Trends and Strategies in the Chemistry of Advanced Materials with Relevance in Biological Systems, Technique and Environmental Protection*, 10th Edition, June 08-09, 2017, Timișoara, Romania.

Applicability and transferability of the results

This custom-made immobilized lipase will be able to catalyze the synthesis of natural esters from natural acids and natural alcohols. There is a high demand for food aroma esters recognized as naturals and the biocatalytic way is the best possibility to synthesize them. Superparamagnetic iron oxide nanoparticles (IONPs) in highly stable ferrofluid formulations will be used to fabricate functionalized magneto-responsive nanobeads for lipase immobilization, resulting in manifold reusable nanoparticle systems of high catalytic efficiency.

Financed through/by

Romanian Authority for Scientific Research and Innovation (UEFISCDI), project number PN-III-P2-2.1-PED-2016-0168, within PNCDI III

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SEISMIC PROTECTION OF ENGINEERING STRUCTURES THROUGH DISSIPATIVE BRACES OF NANO-MICRO MAGNETO-RHEOLOGICAL FLUID DAMPERS – SEMNAL-MRD

Goal of the project:

The goal of the project is to develop a seismic protection system, which uses magneto-rheological fluid (MRF) dampers, acting as semi-active structural control system. Particular objectives are:

- To develop nano-micro MRF compatible with application in seismic MR dampers;
- To design and built a 10tf capacity MR damper;
- To provide type tests, based on EN 15129-2009: Anti-seismic devices, aimed to validate, calibrate and model the damper;
- To design, execute and test a brace-damper assembly in order to validate the integration of damper and brace, including connections;
- To propose structural application schemes for implementation in practice of semi-active control brace-MRD systems.

Short description of the project:

There are three strategies for the seismic protection of structures:
(i) reduce seismic demands,
(ii) enhance structural damping,
(iii) use active or semi-active structural control.
The current project involves the third approach focusing on semi-active systems. Semi-active devices have properties that can be adjusted in real time but cannot inject energy into the controlled system. Many of them can operate on battery power alone, proving advantageous during seismic events when the main power source to the structure may fail. The most promising devices suitable for implementation into a semi-active control appear to be magneto-rheological (MR) dampers, which succeed in overcoming many of the expenses and technical difficulties associated with other types of semi-active devices.

Response characteristics of MR devices can be changed by varying the magnetic field through different current inputs. In addition to its small power requirement, the MR damper can transfer large forces at low velocities. Currently there are MR dampers with capacities up to 200 kN and research results proved the possibility to obtain capacities up to 400-500 kN.

Project implemented by

The Research Centre for Mechanics of Materials and Structural Safety – CEMSIG, Politehnica University of Timişoara.

Implementation period:

01.07.2014 – 30.09.2017

Main activities:

The activities of the project were divided in four stages (I/2014, II/2015, III/2016, IV/2017). All stages are completed.

As part of stage IV/2017, the main activities were:

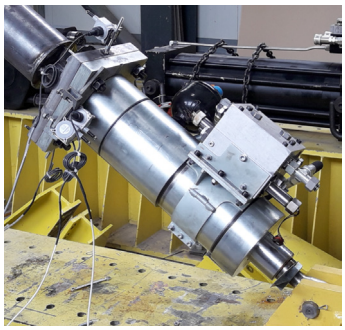
(i) testing of MR damper of 10tf capacity,
(ii) testing of the brace-damper assembly,
(iii) numerical modelling of single- and multi-degree of freedom systems.

The MR damper was tested under different loading conditions. Experimental investigations were performed on two buckling restrained braces (BRBs), under both monotonic and cyclic loading conditions. In addition, tests were performed also on the brace-damper assembly, since the dampers in structural systems will be coupled with braces. A control unit was used for the control of the magneto-rheological damper.

Results:

The results of the fourth stage (IV/2017) comprised:

(i) several testing phases of the MR damper and adjustments for the improvement of the response;
(ii) experimental and numerical investigations of the buckling restrained braces;
(iii) experimental investigation of the brace-damper assembly.



The experimental tests have demonstrated the functionality of this system, but in order to optimize the way it works - there are several aspects of detail to be solved. The functionality of the hybrid system has been demonstrated in the sense that it has highlighted how the dampers work in a first phase, then by electronical control at the work capacity, the damper was blocked and the buckling restrained brace was operating.

Applicability and transferability of the results:

Considering the seismicity of Romanian territory and the effectiveness of the dissipative devices targeted in the project (once under fabrication, the implementation in new and existing structures would be quite easy), the national market potential is very large. On the other hand, this market can comprise all the Balkan's area, including Turkey and Greece, with development potential towards neighboring Asian Countries.

Financed through/by

The project is supported by a grant of the Romanian National Authority for Scientific Research, CNDI–UEFISCDI, project Nr. 77 / 2014 (PN-II-PT-PCCA-2013-4-1656).

Research Center

The Research Centre for Mechanics of Materials and Structural Safety – CEMSIG, Politehnica University of Timisoara.

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- IMS-AR – Institute of Solid Mechanics of the Romanian Academy
- AR-FT – Timişoara Branch of the Romanian Academy
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IMPLEMENTATION INTO ROMANIAN SEISMIC RESISTANT DESIGN PRACTICE OF BUCKLING RESTRAINED BRACES (IMSER)

Goal of the project:

The project aimed at developing a set of typical buckling restrained braces in view of their pre-qualification. Both "conventional" and "dry" devices were considered, with capacities corresponding to typical steel multistorey buildings in Romania. This should lead to a wider adoption of buckling restrained braced frames in design practice, which currently is precluded by the proprietary character of braces, need for their experimental qualification and lack of experience.

Short description of the project:

The project developed, investigated numerically, tested and prequalified a set of buckling-restrained braces.

Project implemented by

- Politehnica University of Timisoara (coordinator);
- SC Popp & Asociații SRL, Bucharest;
- SC HYDOMATIC SISTEM SRL, Timisoara.

Implementation period:

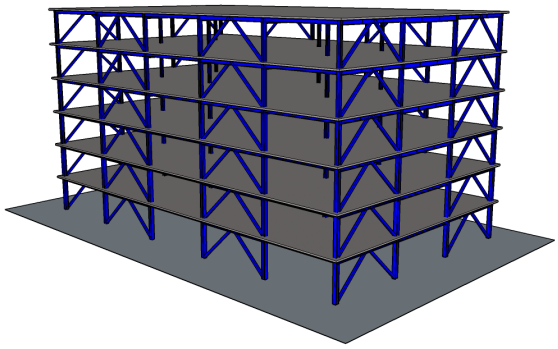
01.07.2014 – 30.09.2017

Main activities:

- Development of two different types of BRB prototypes: "conventional" and "dry", followed by a prequalification testing program on a set of BRBs of different capacity.
- Transfer of the "know-how" on design and production of two types of BRBs to the industrial partner, who will be able to set up quantity production of these devices.
- Development of design guidelines for buckling restrained braces (at the device level). It allows production of generic BRBs by local producers at more competitive prices than imported ones.
- Development of design guidelines and design examples for steel BRB frames (at system level).
- Dissemination of the project outcomes to practising engineers.

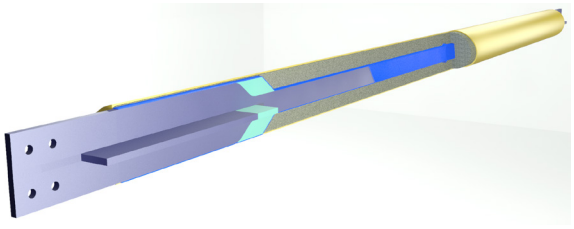
Results:

- Prototype structures (MRFs, BRBFs, D-BRBFs, and CBFs), located in Bucharest and Timisoara were designed. Two typical BRB capacities were selected (300 kN, respectively 700 kN).

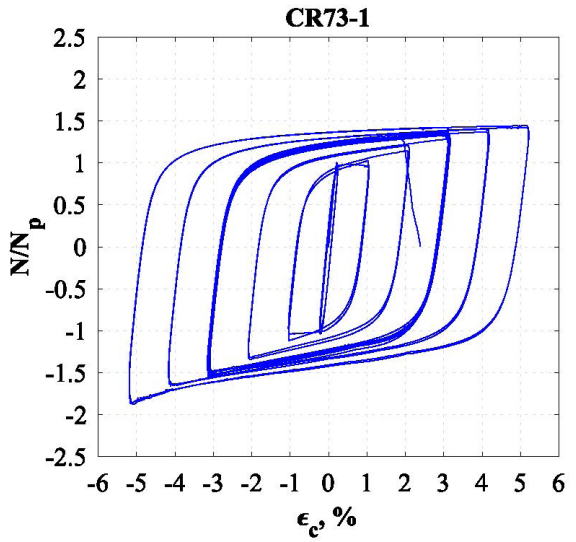


- Seismic performance evaluation of structures was performed using nonlinear static analyses for different seismic performance levels.

- Different BRB concepts were analysed and numerically tested.



- 14 BRB specimens were manufactured and tested experimentally under cyclic loading. Their performance was assessed in terms of force adjustment factors and cumulative inelastic deformations.



- Design guidelines were developed for prequalified BRBs and for steel buckling-restrained braced frames.
- Two workshops were organised (in Timisoara and Bucharest) in cooperation with the Association of Structural Engineers (AICPS), Politehnica University of Timisoara (UPT) and Technical University of Civil Engineering Bucharest (UTCB) for dissemination of project results.

- Research reports and design guidelines developed within the project are available at http://www.ct.upt.ro/centre/cemsig/imser.htm.

Applicability and transferability of the results:

Prototype BRBs were fabricated within the project by one of the partners (SC Hydomatic Sistem SRL). Design guidelines for buckling restrained braces (device level) and for steel structures using BRBs (system level) were developed. Moreover, BRBs were prequalified for capacities in the range of 150-840 kN. It allows structural designers to easily apply this modern structural system in practice. On the other hand, the developed procedure for design of BRBs allows local manufacturing of these devices.

Financed through/by

The project was supported by a grant of the Romanian National Authority for Scientific Research, UEFISCDI, project Nr. 99 / 2014 (PN-II-PT-PCCA-2013-4-2091).

Research Center

CEMSIG - The Research Center for Mechanics of Materials and Structural Safety

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EXPERIMENTAL VALIDATION OF THE RESPONSE OF A FULL SCALE FRAME BUILDING SUBJECTED TO BLAST LOAD - FRAMEBLAST

Goal of the project

The main goal of the FRAMEBLAST project is to provide an accurate validation of the response of a full scale building structural frame system under internal and external blasts in laboratory environment. The structure is subjected to internal and external blasts from different charge weights and locations (standoff, height above ground), resulting in different loading scenarios.

Short description of the project

Explosions produced in urban areas by the detonation of high explosives are low-probability, but high-risk events. When they occur in the immediate vicinity of buildings, the explosions can affect their structural integrity (local/global failure) and harm people (injuries, death). Because the blast threat can only be mitigated, the risk can be reduced by reducing the exposure and vulnerability (enhanced local strength, allow the development of alternate load paths to prevent progressive collapse).

Project implemented by

The project is implemented by a partnership between POLITEHNICA UNIVERSITY TIMISOARA, project coordinator Prof.dr.ing. Florea Dinu and NATIONAL INSTITUTE FOR RESEARCH AND DEVELOPMENT IN MINE SAFETY AND PROTECTION TO EXPLOSION INSEMEX Petrosani, represented by dr.ing. Attila Kovacs. External experts from TECHNICAL UNIVERSITY of CLUJ-NAPOCA and URBAN-INCERC Cluj-Napoca are also involved.

Implementation period

2017-2018

Main activities

- Preliminary analysis, design and fabrication of full scale experimental model
- Experimental tests on full-scale building model under internal blast. Explosive charges are detonated in different locations to acquire information about blast pressure decay and interaction with the structure
- Experimental tests on full-scale building model under external blast. First explosive charges are detonated in different locations to acquire information about blast pressure decay and interaction with the structure. Second test series use increasing explosive charges (charge weight / standoff distance) to cause the column in proximity to fail.
- Validation of a numerical model using Extreme Loading for Structures (Applied Science International, LLC, ASI).
- The development of a procedure to apply structural identification to components of a full-scale building structure with structural damage resulting from the blast pressure.

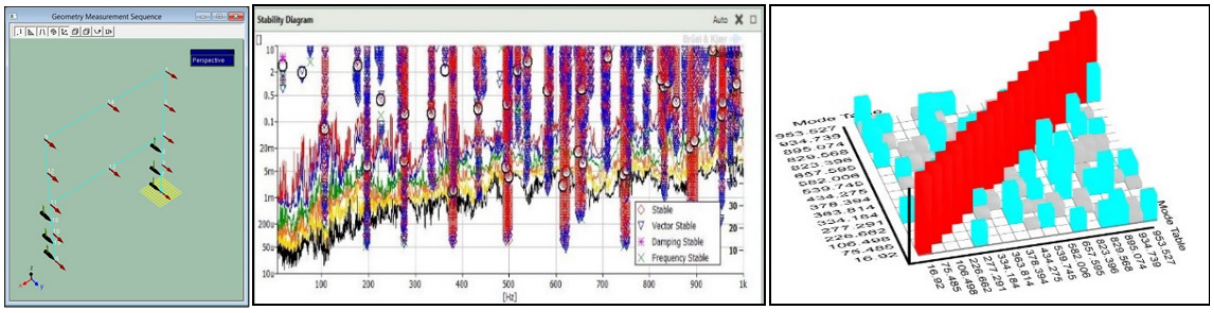
Results

1. Construction phase
- The structure components were brought to the construction site and assembled on-site using bolted connections
- Preliminary internal blast testing were performed using small charge weights (121 g cartridge of explosive)

a) b) c)

Fig. 1 Views with the experimental model:
a) general view; b) view from inside with the position of a test blast charge; c) detailed view of a connection.

2. Experimental modal analysis to assess the dynamic properties of the structure (Bruel & Kjaer vibration measurement technology and equipment
- Experimental modal analyses (EMA) were carried out using hammer excitation and 11 accelerometers
- The modal parameters were verified using the Modal Assurance Criterion (MAC)



a) b) c)

Fig. 2 Modal parameter identification: a) position of the accelerometers and MTC hammer; b) stability diagram; c) modal assurance criterion MAC

3. Preliminary numerical testing using models calibrated against bunker tests
- Blast tests performed on two identical 3D specimen were extracted from a typical moment resisting steel frame structure
- They allowed to make a preliminary calibration of the numerical model of a full scale building structural frame system
- Numerical simulations were performed to evaluate the consequences of close-in detonations on the structural elements

a) b) c) d)

Fig. 3 Numerical simulations using ELS:
a) 3D view of the model tested against external blast; b) relevant blast test inside bunker; c) - d) simulation of local damage for two blast loads

Applicability and transferability of the results

- Experimental validation of an integrated building system in laboratory environment represents the bridge from the scientific research to practical application (structural engineering).
- Experimental database and numerical models are used to upgrade the existing codes for structural design and prevention measures

Financed through/by

This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS/CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2016-0962, within PNCDI III: "Experimental validation of the response of a full-scale frame building subjected to blast load" - FRAMEBLAST (2017-2018).

Research Centre

The Research Center for Mechanics of Materials and Structural Safety - CEMSIG

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FAST WELDING COLD-FORMED STEEL BEAMS OF CORRUGATED SHEET WEB (WELLFORMED)

Goal of the project

The main aim of the project is to test and validate a NEW technological solution for built-up cold-formed steel beams (CWB), with corrugated sheet webs and built-up cold-formed steel flanges, using Spot welding (SW) or Cold Metal Transfer (CMT) connecting technologies.

Short description of the project

The advances in cold-formed steel structures require not only material savings but also high efficiency of production and manpower reduction. The WELLFORMED research project proposes to study a new technological solution for built-up beams made of corrugated steel sheets for the web and thin-walled cold-formed steel profiles for the flanges, connected by SW or CMT welding. Within the research project, the experimental work includes tensile-shear tests on the lap joint spot-welded specimens, were different combinations of steel sheets with various thicknesses were tested and, tests on full scale beams in bending. The study intends to demonstrate the feasibility of the proposed solutions, to assess their performance and to enlarge the knowledge by using numerical simulations for the optimization of the current solution and to define the limits of applicability of the solution.

Project implemented by

CEMSIG - The Research Center for Mechanics of Materials and Structural Safety - Research and Technical Development unit of Politehnica University Timisoara, at the Faculty of Civil Engineering, Department of Steel Structures and Structural Mechanics.

Implementation period

03.01.2017-02.07.2018

Main activities

- design and fabrication of experimental program;
- experimental program on welded connections (SW and CMT) and optimisation of fastening technology;
- experimental program on full scale CWB beams, using SW or CMT connecting technologies;
- numerical investigation of beams and parametric investigations:
  - calibration of numerical models by experimental tests;
  - optimization of technical solutions;
  - design and numerical analysis of specimens with larger spans;
- design guidelines and recommendations for fabrication.

Results

- experimental results on tensile-shear tests on the lap joint spot-welded and CMT specimens (280 small specimens), were different combinations of steel sheets with various thicknesses were tested;
- experimental program on 5 full scale CWB beams, 2 using SW and 3 CMT connecting technologies.

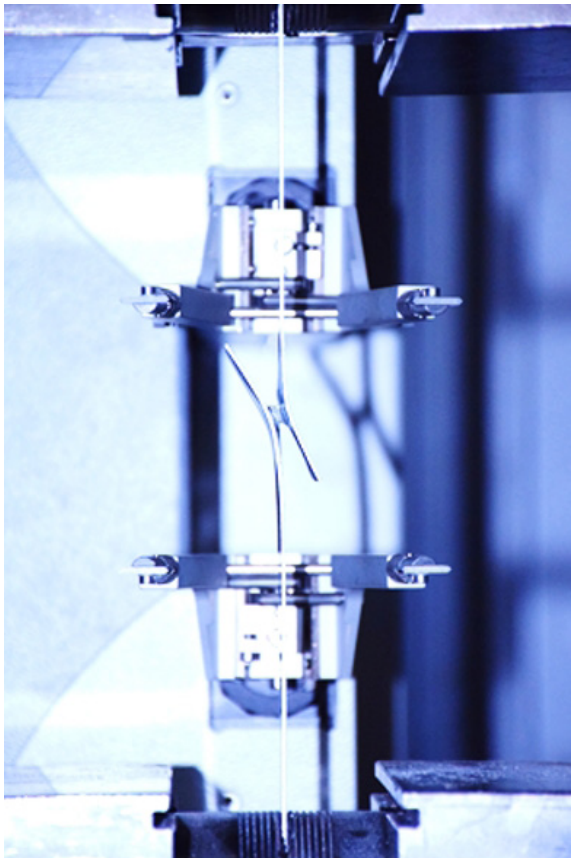

Fig. 1: Full button pull-out failure mode

Fig. 2: SW1 CWB Beam during the test

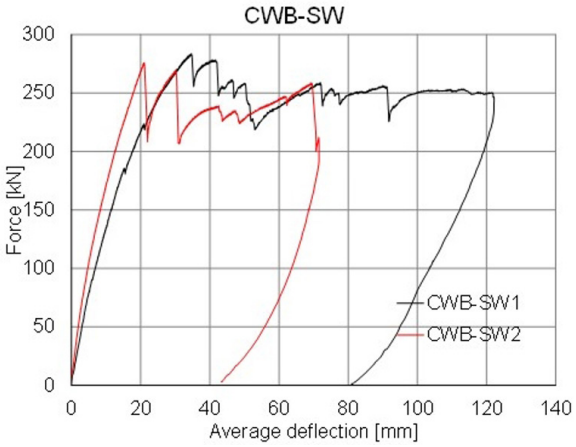

Fig. 3: Force-deflection curve for the full scale built-up beams

Applicability and transferability of the results

The new technical solution is composed of 100% of cold-formed steel components, having high protection to corrosion, due to the fact that all components are galvanised. The solution allows for easy prefabrication, reduced erection time, mass production and high-precision quality control. All of these characteristics are expected to be interesting both for manufacturers and contractors, making steel competitive. Design guidelines and recommendations for fabrication will be provided.

Financed through/by

The project is supported by a grant of the Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI), grant agreement 57PED/2017.

Research centre

Research Center for Mechanics of Materials and Structural Safety (CEMSIG)

Research team

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MICRO-SCADA SYSTEM FOR THE MANAGEMENT OF ELECTRICITY DISTRIBUTION, BASED ON A LORAWAN RADIO COMMUNICATIONS NETWORK

Goal of the project

The project is intended to support activities of experimental development, consisting in combining and using the knowledge and multidisciplinary skills with the main aim of: designing, installing, commissioning, testing and validating a product - commercially usable prototype - consisting of a SCADA micro-system based on a LoRaWAN communications network. The project results will be the subject of the technology transfer from the service provider (UPT) to the beneficiary (MEL) in order to initiate its own capacity to develop similar systems.

Short description of the project

The project includes activities for the design, installation, commissioning and testing of a final product - *a commercially usable prototype:* the functional SCADA micro system, based on a LoRaWAN communication network, with functions of optimizing the operation of the electrical network distribution from Straja Skiing Domain.

Project implemented by

SC MELIOR ELECTRO ENERGY SRL DEVA – beneficiar;
Politehnica University Timișoara, Power Engineering Department – research service provider.

Implementation period

25.07.2017 - 24.12.2017

Main activities

The SCADA micro system was designed as modules and components whose structures and functions are:
1. Universal radio communication module type W-COM01.LN4SEM;
2. Supply and extension I/O remote wiring module type 4DI4DO / 2RI - PS24 / 10;
3. High gain directive antenna kit for ISM band - EU 868 MHz;
4. Witness energy meter type CST 0410 - ACSMRQCL;
5. LoRa Bus for SCADA nicrosistem- Reactive Power Acquisition / Compensation Command;
6. RS232 / Ethernet Module - Server Device.

The optimal configuration of the system result:

- CDA bus - LoRaWAN access role; will be done with a RS232 / Ethernet Server Device (Network Server role);
- The Application Server (Central Control Unit) will be a computer in AIO configuration and will also be installed in the CDA bus;
- CDA buses (access point) and Conx bus (Enel - 20 kV cable beginning connection point) will be connected via the radio network,
- The Conx bus will be connected to the 20/0.4 kV transformers: PT1, PT2, PT2A.

Results

The results of the research activities carried out by the service provider will materialize in the design documentation, installation, commissioning and testing of a final product - a commercially usable prototype: a functional SCADA micro system based on a LoRaWAN communications network for the management of the electrical distribution network from Straja Skiing Domain. The main functions of the system are as follows:
- Conx bus: LoRaWAN's central node role, manages multicast messages for synchronized acquisition, provides a secure radio link with CDA (Ethernet access point); collects data from the CST0410 witness meter;
- CDA bus: access point role in the LoRaWAN network - private; uses the RS232 interface to connect to the Network Server; execution role for switching the B1 and B2 coils;
- PT1 and PT2 buses: will contain future energy meters to register the consumers connected to them.

Applicability and transferability of the results

The results will be the subject of a technology transfer (know-how) from the research service provider (UPT) to the beneficiary (MEL) in order to initiate its own capacity to develop similar systems for the market, which will contribute to the development company and increasing its competitiveness.

Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding – UEFISCDI, *Competition: PNCDI III - Program 2, Subprogram 2.1 – Innovation Checks, PN-III-CERC-CO-CI-2017.*

Research centre

Analysis and Optimization of the Electrical Power Systems Regimes

Research team

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PhD. Student Sorin POPESCU
– key person, Applied Electronics Department.
Assoc.prof.PhD Florin MOLNAR-MATEI
– Power Engineering Department;
Lecturer PhD. Ilona BUCATARIU
– Power Engineering Department;
Student Florin POPESCU
– Automation and Computers Faculty, software developer.

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INTELLIGENT DEVICE FOR CAPACITOR BANKS PROTECTION AGAINST THE EFFECTS OF HARMONIC CONDITIONS WITHIN THE ELECTRICAL DISTRIBUTION NETWORKS

Goal of the project

Within the project was developed and tested an intelligent device for capacitor banks protection against the effects of harmonic conditions within the electrical distribution networks.
Installing a capacitor bank in a bus of an electrical network containing harmonics leads to the amplification of the harmonic conditions and to the risk of exceeding the admissible operating limits for the capacitor bank, regarding the current and voltage values, provided by the standards. The amplifications of harmonic currents or voltages can damage the capacitor. These risks can be predicted by real-time determination of the network harmonic impedance seen in the compensation bus.
Implementation of such an intelligent system will produce mainly two positive effects:
– Increasing the operational safety of the electric installations by reducing the number of capacitor bank failures.
– Reducing the costs for consumers by reducing the direct costs caused by the need to replace the damaged capacitors, and the indirect costs caused by the increased consumption of reactive power due to their out of service.

Short description of the project

The intelligent device is based on a microcontroller and its operating principle is to determine in real time the harmonic impedance and, based on its values, to anticipate the harmonic conditions effects on the capacitor bank.

Results

– The main outcome of the project is a functional experimental model and its documentation of implementation for an intelligent device for capacitor banks protection against the effects of harmonic conditions within the electrical distribution networks.
– A patent application has been filed within the project

Project implemented by

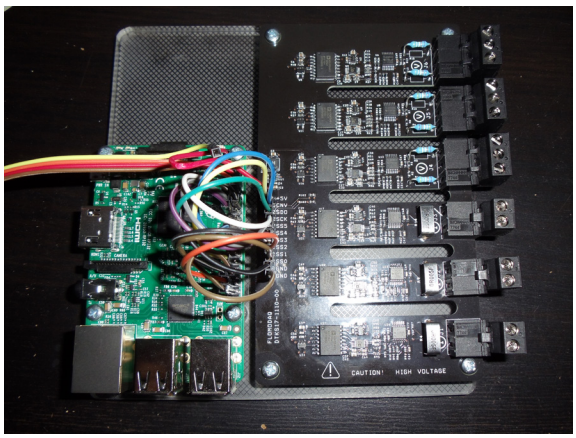
Politehnica University Timisoara – Research Service Provider
S.C. Energomecanica Serv S.R.L. – Beneficiary

Implementation period

25.07.2017 – 31.12.2017

Main activities

– Elaboration of the intelligent device execution documentation
– Construction and commissioning of the intelligent device
– Testing the device operation
– Optimizing the device operation
– Protection of intellectual property rights



Applicability and transferability of the results

The project was carried out under *Check of Innovation* financing instrument which means that since from the beginning of the project the applicability and transferability of the results has been ensured.
The beneficiary of the main result of the project, the intelligent device, is actually the beneficiary of the project, S.C. Energomecanica Serv S.R.L., which is an energy provider on an industrial platform.
The device can also be replicated for any consumer that uses capacitor banks for power factor improving.

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation - UEFISCDI

Research centre

Analysis and Optimization of the Electrical Power Systems Regimes

Research team

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TESS - THERMO-ELECTRIC HYBRID SOLAR SYSTEM

Goal of the project

The project relates to a solar thermal - electric hybrid, which produces hot water and electricity using thermoelectric modules.

Short description of the project

The system is composed of thermoelectric modules, and solar concentrator photovoltaic cells that convert heat to increase efficiency and reduce losses by convection, using a vacuum chamber that allows the positioning unit conversion at any position and allows adjusting the amount wastewater heat transferred by replacing hexagonal mirror solar concentrator photovoltaic.

Project implemented by

Department of Applied Electronics, Politehnica University Timisoara

Implementation period

03.01.2017 – 31.03.2018

Main activities

Mechanical system implementation
Full working prototype
Experimental validation
Final stage

Results

- 2 published Journal papers (Thomson Reuters WoS) IF>1.5, Q2 and Q3
- 2 ISI Journal papers (under review)
- 8 ISI conference papers
- 2 patents

Applicability and transferability of the results

- Effective solution for domestic use
- Tool for complex modeling, simulation and measurement
- Real time flow control

Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Bucharest, Romania.(UEFISCDI), PN-III-P2-2.1-PED-2016-0074, 499.700 RON (110.800 EUR)

Research centre

Intelligent Electronic Systems, http://www.ccesi.etc.upt.ro/

Research team

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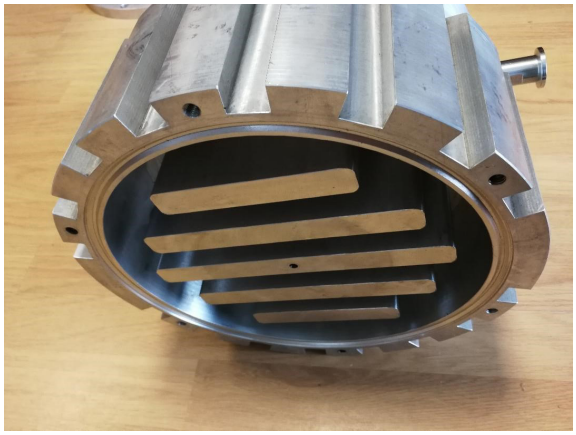
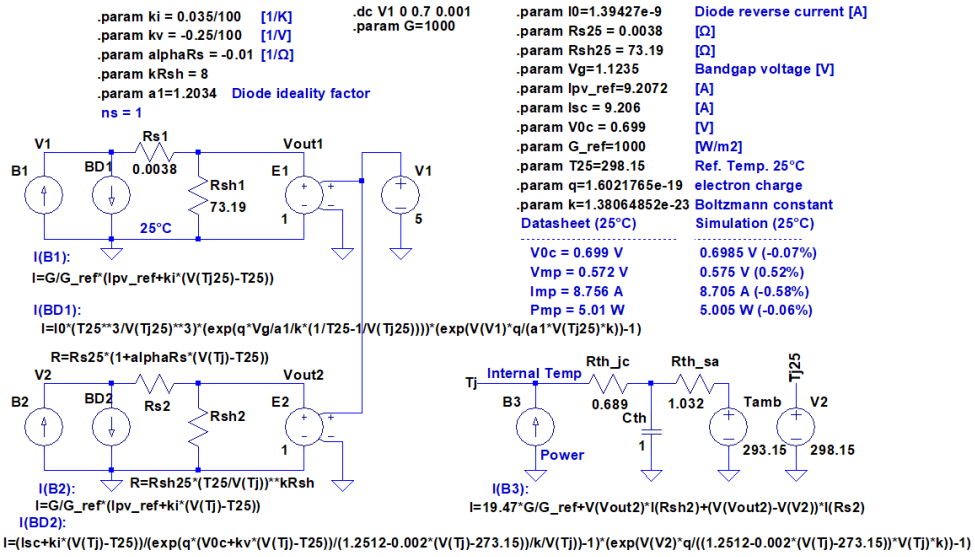
Roland SZABO
Szilard BULARKA
Alexandru SFIRAT





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INTELLIGENT CONTROL SYSTEM FOR CONTINUOUS CASTING BASED ON WATER FLOW CONTROL IN THE SECONDARY COOLING

Goal of the project:

The primary objective of the research which will be made in this project is the development and implementation of the leading structure for the continuous casting process (on the secondary cooling zone) leading to eliminate quality defects and throw-outs, by adjusting the flow of the secondary cooling water. In the context of this objective it is proposed the synthesis and the development of some leading solutions for the continuous casting process using fuzzy logic, allowing to control flow of the secondary cooling water, by distribution areas. This necessity is imposed by the fact that nowadays control systems are rigid and are limited at a rigid repartition of the flow water in each area. An intelligent system has the capacity to eliminate this disadvantage of the nowadays systems by having the possibility to modify in real time this repartitions of the water flow taking into consideration what happens in the installation.

Short description of the project:

Leaving from the installations geometry with 3 cooling areas it was create 3 fuzzy regulators for each area separately, each one having 3 inputs. After the 3 fuzzy regulators was done was designed a fuzzy adaptive system which correlates the three cooling areas so that the water flow to be the same. For example if the water flow is lowed in the first area it will automatically increase the water flow in the second and third area so that it will be the same value of the water flow but the repartition on each area will be different.

Project implemented by

The proposed solution was implemented in the continuous casting process within S.C. Arcelor Mittal S.A. Hunedoara. The Continuous Casting Plant within the "Continuous Casting" section of the S.C. Arcelor Mittal S.A. Hunedoara is designed and manufactured by Manesman company and comprises five yarns for pipe billets with diameter Φ180 mm, Φ200 mm, Φ250 mm, Φ270 mm, Φ310mm or blanks for re-rolling with dimensions 240x270 mm, 310x280 mm.

Implementation period:

01.10.2015 - 30.09.2017

Main activities:

1. Analysis of the existing charts and databases. Practically, any continuous casting plant has a database containing the occurred events, the current operating mode and the casting recipes applied to various types of steel grades, all these leading to providing the data required to correctly approach the steps listed below.
2. Fuzzy Intelligent Systems Design. We must define the input and output variables and design the rules required to build the fuzzy controllers for each cooling area.
3. Testing and validation by simulation of the designed fuzzy controllers. Dissemination of results.
4. Realization of sensor interface for the process-driven data acquisition.
5. Software implementation of the fuzzy controllers on a PLC S7 300. The PLC is integrated in the wiring diagram of the continuous casting process. Modification of the SCADA system for observing the corrections made by the newly implemented systems.
6. PLC integration in the continuous casting plant, testing and validation of the proposed solutions, dissemination of the obtained results.

Results:

Experiments have shown that the proposed Fuzzy solution is extremely efficient and much higher than current flow control solution, and can be implemented relatively easily on any continuous casting installation without requiring any significant changes from the hardware point of view of the existing installation.

Applicability and transferability of the results:

Experiments were performed for 3 different profiles of the semi-finished product, namely Φ180mm, Φ200 mm, Φ 250 mm, but the same mark 20MN10. On a PLC identical to the laboratory used in the "Continuous Casting" Section of S.C. Arcelor Mittal S.A. Hunedoara, the completely created program (the classical / fuzzy method) was transferred. In the first phase, the PLC only had the role of recording, storing and processing the data in order to validate its proper operation, without being able to control the flow, cooling by the classical method. After validation of the proper operation, the PLC was connected to the system (making the connection with valves), then 3 sets of castings were made using the software.

Financed through/by

UEFISCDI

Research Center

Faculty of Engineering Hunedoara

Research team

Project leader:

Assoc.prof. PhD. eng. ec. Tirian Gelu-Ovidiu

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Lecturer PhD. eng. Rob Raluca
PhD's. eng. Ghiormez Loredana
PhD's. eng. Gheorghiu Csaba Attila

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PERFORMANT POWER TRAIN FOR HYBRID AND ELECTRIC VEHICLES WITH DUAL ROTOR SINGLE STATOR AXIAL SYNCHRONOUS MACHINE AND SINGLE INVERTER - HELSAX

Goal of the project:

The project goal of bilateral cooperation between the UPT-TUIASI and UTM proposed, is of major scientific and practical importance in reducing pollution from vehicles classic using hybrid vehicles or electric drive systems performance, and aims to develop and enhance knowledge of joint research teams from Romania and Moldova, as well as enhance mobility of researchers, exchange of experience and mutual access to research infrastructure of medium and high scale, existing in the three universities.
The basic priority of the collaboration is to develop, during the implementation of the joint project, of a scientific project for participation in competitions announced by Horizon 2020 of the European Union and other international programs.

Short description of the project:

It proposes an international original solution in which the two electrical machines (generator and motor) and static converters related are replaced by a single synchronous permanent magnet machine having axial air gap, a central stator with slotes on both sides and two different windings supplied from a single PWM inverter having two output frequencies, and two independent rotors.

Project implemented by

Politehnica University of Timisoara (UPT),
Technical University "Gheorghe Asachi" Iaşi (TUIASI) and
Technical University of Moldova (UTM)

Implementation period:

September 2016 – March 2018

Main activities:

The aim is to exploit the potential of joint research of the two teams for creating a system of electric drives for hybrid vehicles and electrical overall dimensions and low weight; reduce carbon emissions from vehicles; have a static converter that is simple and inexpensive; broadcast transmission system using differential electric vehicles; control of the two rotors so that they can operate in the same mode or in different modes at the same rotational direction or in opposite directions at the same speed value at slightly different speeds or at much different speeds. Specific objectives: increasing electrification of the vehicle; reducing vehicle weight; increasing the speed of operation of the electrical machine rotors for reducing the size of the actuator; sizing model for which the design (impose conditions of power, size, weight); design model for the electric drive system and the stand of experimental tests; increasing efficiency for the electric drive system; the practical design of the machine, inverter and battery accumulators; exhibition experimental test setup; implementation and testing of the various experimental control solutions; creating an intelligent system for managing production and electricity consumption per vehicle. Expected results: a much easier vehicle with an electric drive system; low inertia rotor at high speeds; a compact electric drive system with high torque and simple control; an inverter that manages various operation modes with different speeds equal to or in the same direction or in opposite directions of the two rotors.

Results:

The work plan in 2016 was based on regular meetings of members of both teams alternately in Romania and Moldova. First visit was in Moldova, by a team from Romania. On this occasion the Romanian members met the team members from Moldova, visited research labs, they did contact with their scientific concerns. During this movement, a conference occurred, in order to launch the project in Chisinau, where teachers and students from the Technical University of Moldova and specialists in electrical engineering enterprises in Chisinau, Balți and Tiraspol were invited .
Then followed a visit by a team from UTM to Faculty of Electrical Engineering and Energetics in Timisoara and the Faculty of Engineering Hunedoara. On this occasion contact were established with all members of the project team from Romania, were visited research laboratories of the two faculties, and there was group discussions between members of both teams according to scientific areas of joint research. One conference was organized in order to launch the project in Timisoara, where teachers and students at the University Politehnica Timisoara and specialists of enterprises of Timisoara and Arad with automotive profile were invited. There was a travel team from Chisinau to visit industrial companies in the automotive industry in Hunedoara and Deva (Lisa Draexlmaier Hunedoara, Sews Deva).

Applicability and transferability of the results:

The motors excited by permanent magnets in a variety of designs, gaining more ground in the competition with the DC classics, because of high technical and economic achievements, especially under current conditions, in association with improved electronic supply sources and assisted computer systems that are more and more competitive. Obtaining reasonable torque values for a wide range of variation of speed, drive systems through simple procedures, are no longer a difficulty that cannot be solved. Using motors excited by permanent magnets and brushless fractional number of slots per pole and phase engines in particular, as actuators in servo-drives for low power and area, has expanded compared to the classic DC due to the progress of power electronics and information technology, without which one can not conceive an elastic system containing modern drive controllable speeds in wide range. With integrated systems for the electric drive, having adequate topologies actuators as execution elements , through the use of more evolved control algorithms and integrating functionality at both hardware and software, may lead to dynamic and superior performances, more precise control of speed or position, high electromagnetic torque, higher energy efficiency and high accuracy while simultaneously reducing overall system cost consistently. The project results will contribute to community social objectives to combat climate change. The main contribution is to reduce emissions of CO2 and emissions of greenhouse gases. The project proposes new technologies and contributes to sustainable economic development.

Financed through/by

UEFISCDI

Research Center

UPT members of the research team are also members of the University's two research centers: the Institute for Renewable Energy and Research Centre for the intelligent control of power conversion and storage.

Research team

The research team consists of UPT coordinator conf.dr.ing. Sorin Ioan DEACONU, teachers (PhD's): Nicolae MUNTEAN, Lucian Nicolae TUTELEA, Liviu MIHON, Octavian CORNEA, Ciprian ŞORÂNDARU, Marcel TOPOR, engineers and PhD students: Loredana GHIORMEZ and Csaba GHEORGHIU.

Informbusiness Chişinău laboratory for experimental work.

Helsax project launch conference in Chisinau.

Helsax project launch conference in Hunedoara.

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INNOVATIVE, ECOLOGIC AND EFFICIENT TECHNOLOGIES FOR JOINING METALLIC AND POLYMERIC MATERIALS USED IN AUTOMOTIVE INDUSTRY BY FRICTION STIR WELDING (INOVA-FSW)

Goal of the project

The project is focused on studying the possibilities of using Friction Stir Welding (FSW) for joining dissimilar material (metallic and polymeric) for automotive industry. Solid state welding process, like FSW, avoid the precipitation of secondary phases in the welded joint, resulting a high quality welded joint, even between materials impossible/difficult to weld with fusion welding processes. The main goal of the project is to obtain welding technologies for joining Al-Cu, Al-Steel, as well as different polymeric materials.

Short description of the project

The project studies the possibility to join, by FSW, Al-Cu, Al-steel and different types of polymeric materials.

Project implemented by

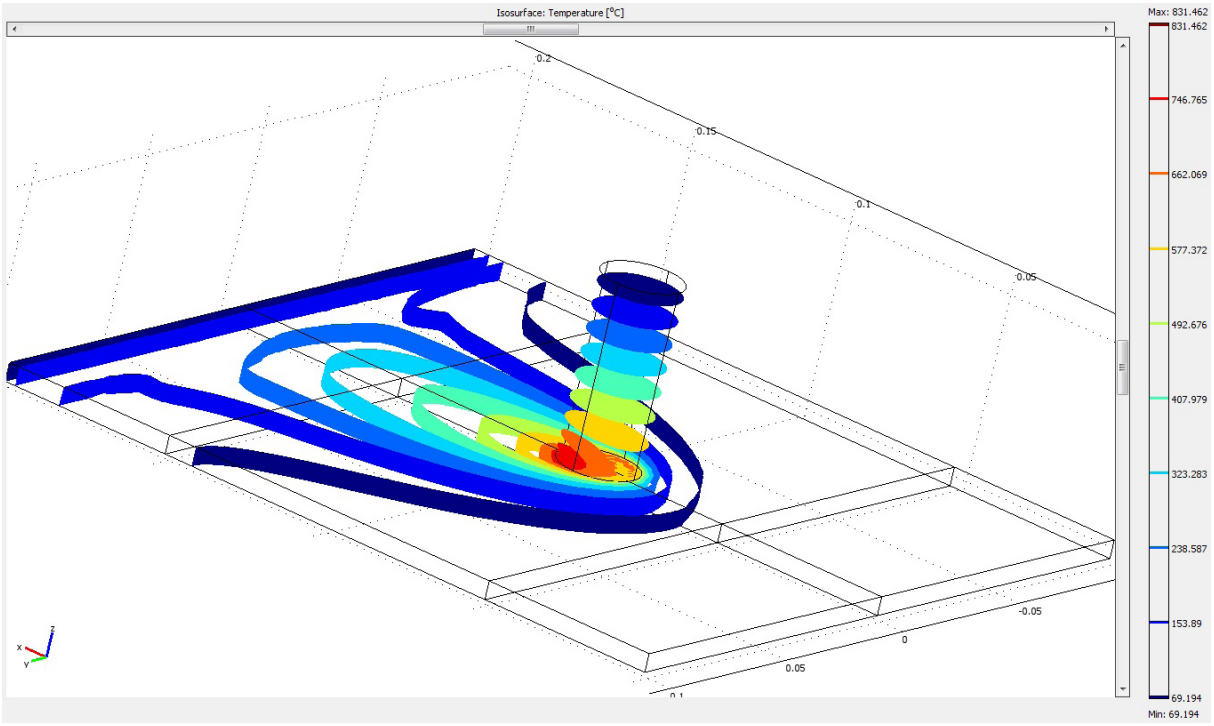
The partners in this project are: University Politehnica Timisoara (UPT), National R&D Institute for Welding and Material Testing – ISIM, Timisoara, University of Pitesti and Renault Technologie Roumanie (part of the Renault Group). The last partner will also implement the results of the project.

Implementation period

14.07.2014 – 30.09.2017

Main activities

The main activities of the project:
- defining the materials for the welding tools, technological parameters, testing procedures and quality specifications;
- experimental studies for joining Al (and aluminum alloys) with Cu (and copper alloys) and different polymeric materials;
- experimental studies for joining Al (and aluminum alloys) with steel;
- numerical modeling of FSW welding of dissimilar materials;
- testing of welded joints, optimization of the welding procedures (building a data base with results);
- dissemination of the results.



Results

The project results are materialized in more than 10 FSW technologies (tested and certified), for joining aluminum alloys with copper alloys, aluminum alloys with steel and also different polymeric materials. Also, there were 6 scientific papers that were published, based on the results of this project.

Applicability and transferability of the results

The re4sult of the project will be transferred and applied mainly at the partner Renault Technologie Roumanie (part of the Renault Group), but they are available to all industrial entities working mainly in automotive industry.

Financed through/by

UEFISCDI in grant PN-II-PT-PCCA-2013-4-1858 (Inova-FSW, contract 219/2014).

Research Centre

ICER – Institutul de Cercetari pentru Energii Regenerabile

Research team

University Politehnica Timisoara (UPT);
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Renault Technologie Roumanie (part of the Renault Group).

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KNOWLEDGE MANAGEMENT-BASED RESEARCH CONCERNING INDUSTRY-UNIVERSITY COLLABORATION IN AN OPEN INNOVATION CONTEXT (UNIINOI)

Goal of the project

In the present competitive climate, knowledge and innovation are seen as the main distinguish factors of the organizations' success and as the basis of their competitive advantages. Following a long tradition of research in the field of innovation, open innovation is an approach in which the boundaries of innovation are shifting from a situation where organizations conduct research and development activities mainly internally, to a widespread collaboration and external knowledge source, in order to support achieving and sustaining continuous innovation of their product, services or processes. Furthermore, universities are seen among the most important partners with whom business organizations can cooperate for quantitative empirical evidence concerning the development, evolution and sustainability of Industry-University relations in Open Innovation. Despite the intensive efforts from both sides for the development of bilateral collaborations in the research and innovation field there are still space and resources for increasing the knowledge processed between these actors.

Short description of the project

The project activities are focuses on designing a feasible strategy (based on a model and an associated methodology) for the UNIinOI together with the definition of a set or a system of key performance criteria in order to characterize this process. The validation of the whole proposed approach for the increasing of the UNIinOI is developed in the case of Romanian universities and industrial organizations. All partners in the project will support the design and validation process of the model and methodology designed solutions..

Project implemented by

Project coordinator - University of Oradea www.uoradea.ro
Partener 1 - Politehnica University of Timisoara www.upt.ro
Partener 2 - Technical University of Cluj-Napoca www.utcluj.ro
Partener 3- S.C. EMSIL TECHTRANS S.R.L. Oradea, Romania

Implementation period

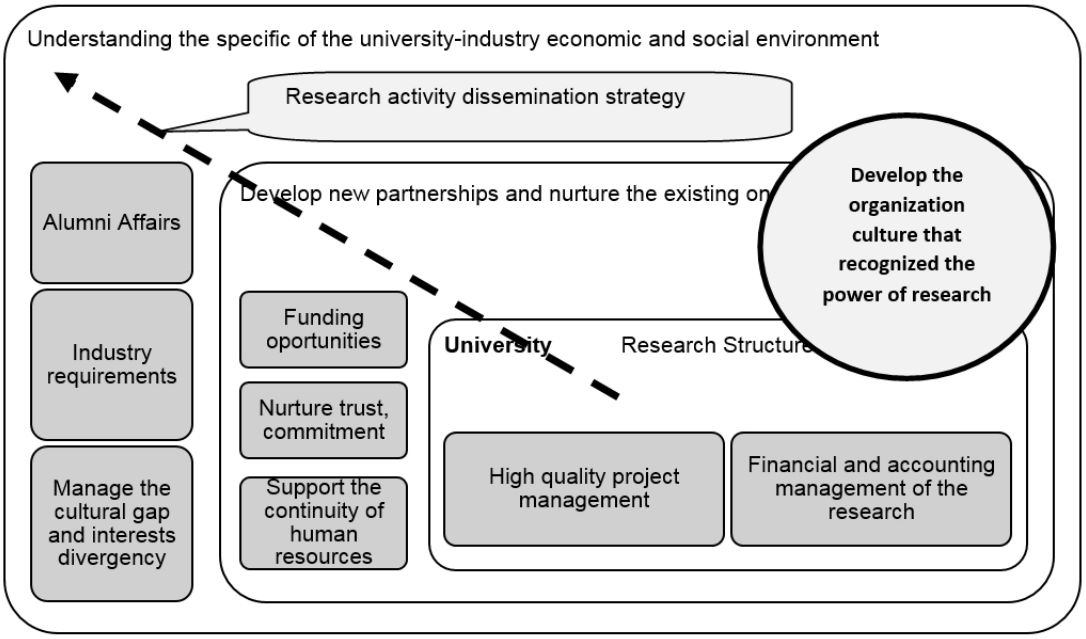
2014-2017

Main activities

Stage I - The development of the collaborative research environment (2014)
Stage II - The development of an Open Innovation environment between Industry-University (2015)
Stage III - The development of a model for the performance measurement of Industry-University collaboration in Open Innovation (2016)
Stage IV - The development of a methodology (associated with the previous designed model) for the performance measurement of Industry-University collaboration in Open Innovation (2017)

Results

During the project implementation there have been developed the ontology of UNIinOI (Fig. 1) using an appropriate software application for the knowledge map design and visualization. The ontology representation has a tree structure that include the description of each considered item as: motivation factors, barriers, channels for the knowledge transfer, benefits and disadvantages (dimensions of the proposed ontology considered as sub-ontologies). The ontology of UNIinOI allows the analysis and optimization of the different knowledge transfer processes, activities or interdependences by considering different items depicted in each sub-ontology. Therefore, each item has been detailed, for its complete characterization using relevant, actual references and existing regulations, norms for research and development activities in Romania.



The proposed model (or framework) for the UNIinOI

Applicability and transferability of the results

1. The projects' research results could be transferred in universities practices in order to define the strategy with its industrial partners in the local and regional areas (derived from a business model). In addition, the results could be useful for the internal procedures development and for the definition of a scientific framework in order to strength and intensify UNIinOI (including the development of future joint projects);
2. The research results could be easy transfer to industrial entities in order to foster UNIinOI;
3. Project's research results were transferred in the didactical process (master level) and enriched the knowledge bases of our didactical and PhD students' projects.

Financed through/by

The project is supported by the Ministry of National Education through The Executive Unit for Financing Higher Education, Research, Development and Innovation in the context of Partnerships in Priority Domains Programme.

Research Centre

Engineering and Management Research Center

Research team

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THE IMPACT OF THE ECONOMIC AND FINANCIAL STABILITY ON INVESTMENTS, INNOVATION PROCESS AND ENTREPRENEURIAL ACTIVITY IN THE EU (ISIIA)

Goal of the project

The aim of the project is to analyze the relationship between economic and financial stability on the one hand, and investment, innovation and entrepreneurship on the other hand, with a focus on the EU countries. The purpose is to see how the degradation of macroeconomic conditions and firms' access to finance influence their investment behavior and the entrepreneurial activity. For this purpose we use firm-level statistics (AMADEUS database) and perform sectorial comparison at EU level.

Short description of the projects

The economic and financial stability plays an important role in promoting investment, in influencing the entrepreneurs' decisions and in enhancing the national innovativeness capacity. These aspects, extremely important for the European strategy for economic recovery and job creation are not sufficiently explored in the literature, while their empirical investigation is practically inexistent.

Project implemented by

Politehnica University of Timisoara

Implementation period

01.10.2015 – 30.09.2017

Main activities

1. We develop the research on three directions:

   - analyze the link between stability and investments, considering the sectorial particularities of the investments' determinants, using FDI and firm-level data.
   - investigate the role of the stability in enhancing the national innovativeness capacity.
   - explore the relationship between the economic stability and the entrepreneurial activity, to see which are the economic sectors where the entrepreneurial decision is sensitive to the evolution of the macroeconomic fundamentals.

2. Manipulation of AMADEUS statistics for firms' financial statements

3. Econometric analyses and generation of results

4. Dissemination of results in international conference

5. Collaboration with international researcher and research stages for young researchers involved in the project

6. Publication of empirical findings in high-ranked journals

Results

Publications:

- Albulescu, C.T., Oros, C. and Tiwari, A.K. (2017). Is there any convergence in health expenditures across EU countries? Economics Bulletin,37(3), 2095-2101.
- Albulescu, C.T., Aubin, C. and Goyeau, D. (2017). Stock prices, inflation and inflation uncertainty in the U.S.: Testing the long-run relationship considering Dow Jones sector indexes, Applied Economics, 49(18), 1794-1807.
- Albulescu, C.T., Miclea, S., Suciu, S.S., and Tamasila, M. (2017). Firm-level investment in extractive industries from CEE countries: the role of macroeconomic uncertainty and internal conditions, Eurasian Business Review, https://doi.org/10.1007/s40821-017-0079-3.
- Albulescu, C.T. and Ionescu, A.M. (2017). The long-run impact of monetary policy uncertainty and banking stability on inward FDI in EU countries, Research in International Business and Finance, https://doi.org/10.1016/j.ribaf.2017.07.133.
- Albulescu, C.T. and Tiwari, A.K. (2017). Unemployment persistence in EU countries: new evidence using bounded unit root tests, Applied Economics Letters, https://doi.org/10.1080/13504851.2017.1368979.

Research Stages:

Șerban Miclea (Université de Poitiers, CRIEF)
Claudiu Albulescu (Université d'Orleans, LEO)

Applicability and transferability of the results

The findings have practical implications for investment and financial managers of companies operating in different economic fields. The results have also practical implication for fiscal and monetary authorities, helping them to identify the elements that enhance the investment and the entrepreneurial activity, in order to sustain the economic growth and job creation. Further, relying on a sectorial analysis, the findings give a complete understanding about the determinants of investment and entrepreneurship, specific to each industry.

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation - UEFISCDI

Research Centre

Engineering and Management Research Centre

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ENVIRONMENTAL ENERGY HARVESTING HYBRID SYSTEM BY PHOTOVOLTAIC AND PIEZOELECTRIC CONVERSION, DC/DC TRANSFORMATION WITH MEMS INTEGRATION AND ADAPTIVE STORAGE

Goal of the project

The design, building and testing of the prototype of a hybrid system for energy harvesting from the ambient through photovoltaic conversion, DC/DC transformation with MEMS integration and adaptive storage, will be carried out. A key novel component is the planar power micro-transformer for high frequency, with hybrid magnetic nanofluid/ferrite core and windings fabricated in MEMS technology, a part of the DC/DC converter. A second key component is the photovoltaic cell, which relies on novel solutions.

Short description of the project

A prototype with wireless sensors powered by the harvesting system was designed, built and tested. In this endeavor, there was prepared a dedicated magnetic fluid to be used as core of a micro-transformer, designed accordingly and tested. Further, an experimental model of the energy harvesting hybrid system was elaborated, designed and tested. Finally, a prototype for the harvesting device was designed and tested for a particular application.

Project implemented by

- National Institute for R&D in Electrical Engineering ICPE-CA Bucharest (Coordinator),
- Politehnica University of Timisoara (Partner 1),
- Romanian Academy – Timisoara Branch (Partner 2),
- Politehnica University of Bucharest (Partner 3),
- SYSCOM PROCESS CONTROL LTD (Partner 4).

Implementation period

July 1st, 2014 – September 30, 2017

Main activities

The main activities are as follows:

(I) elaboration of the experimental model of the energy harvesting hybrid system by photovoltaic conversion and DC/DC transformation with MEMS integration;

(II) design and testing of the experimental model of the energy harvesting hybrid system by photovoltaic conversion and DC/DC transformation with MEMS integration;

(III) design and testing of the prototype of the energy harvesting hybrid system by photovoltaic conversion and DC/DC transformation with MEMS integration.

The 2017 year research aimed to complete the third main activity. Politehnica University team (P1) was responsible for measuring the electrical properties of the magnetic nanofluid samples used in all tests and participating to the planned testing activities and dissemination.

Results

The main result of the project will be the integration of an innovative photovoltaic conversion system and an original DC/DC converter, which utilizes a planar, spiral, MEMS, hybrid (magnetic nanofluid/ferrite) cored micro-transformer in an efficient device for energy harvesting. Regarding the use of a magnetic nanofluid core micro-transformer for the DC/DC converter, from the manufacturing point of view, it is expected that once the appropriate magnetic nanofluid characteristics are established, it will offer an easier way of obtaining the transformer core compared to a solid one. From the operating point of view, it is expected that by replacing the solid core with a liquid core will result in a better heat dissipation and reduction of the thermal stresses in the micro-transformer, leading to a longer life-cycle, maintaining or even improving the electric characteristics.
The results obtained in 2017 were disseminated through:

[1] Lucian Pîslaru-Dănescu, Gabriela Telipan, Floriana D. Stoian, Sorin Holotescu, Oana Maria Marinică, Chapter: Nanofluid with Colloidal Magnetic Fe3O4 Nanoparticles and Its Applications in Electrical Engineering, published in book "Nanofluid heat and mass transfer in engineering problems", Editor Mohsen Sheikholeslami Kandelousi, ISBN 978-953-51-3008-6, InTech Open, Croatia, 2017, DOI: 10.5772/65556.

[2]. Oana Maria Marinică, Study of Static Magnetic Properties of Transformer Oil Based Magnetic Fluids for Various Technical Applications Using Demagnetizing Field Correction, Journal of Nanomaterials, Volume 2017, Article ID 5407679, 9 pages, Hindawi, doi.org/10.1155/2017/5407679.

[3] Vlad Socoliuc, Daniela Susan-Resiga, Corina Vasilescu, Oana Marinică, Izabell Crăciunescu, Tünde Borbáth, István Borbáth, Alin Bosioc, Sebastian Muntean, Nicolae Calin Popa, Rodica Turcu, Ladislau Vékás, Ferrofluids and nano-micro composite fluids: high magnetic response and optimized magnetorheological behaviour tailored for specific applications, presented at 2nd Global Congress & Expo on Materials Science and Nanoscience, 25 – 27 September 2017, Valencia, Spain

Applicability and transferability of the results

The product can bring added value for further development as an end-product to the industrial partner. Possible applications are characterized by their placement in hard to reach places, isolated and without local and/or conventional sources. Among these are applications for industrial automation, monitoring of various parameters in industry (pressure transducers mounted in the gas distribution networks, device multiparameter probes mounted in drinking water distribution networks and others), in agriculture (humidity and soil temperature sensors), for surveillance and monitoring of perimeters.

Financed through/by

Ministry of National Education through the Executive Agency for Higher Education, Research, Development and Innovation Funding, Partnerships in priority S& T domains Program PN II, Joint Applied Research Projects PCCA 2013.

Research centre

Research Center for Complex Fluid System Engineering,
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URL: http://mh.mec.upt.ro/ccisfc/

Research team

The research team of Politehnica University of Timisoara is consisting of three senior researchers, one PhD student and two research assistants:

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Lect. Dr.-Eng. Math. Sorin HOLOTESCU,
Phys. Oana MARINICA,
Assoc.Prof. Dr.-Eng. Nicolae Crainic,
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http://www.icpe-ca.ro/lib/files/asemems-harvest.pdf

VALORIZATION OF ENERGETIC POTENTIAL FOR AGRO-INDUSTRIAL RESIDUES THROUGH BIODEGRADATION PROCESSES AND CATALYTIC COMBUSTION OF OBTAINED BIOGAS

Goal of the project

Determination of the best recipes with the help of mathematical apparatus (mathematical modeling) in accordance with the experience accumulated so far, for obtaining biogas with the best characteristics in terms of quality and quantity; testing at laboratory level (volumes between 1 and 6 liters) for substrates identified as being the most suitable for anaerobic fermentation process; for the existing pilot installation there will be made modifications for process optimization through increasing the control degree for process parameters and improvement of material homogeneity during the residence time inside the reactors. The obtained experimental values will be compared with the ones obtained from modeling processes and corresponding conclusions will be traced; biogas capitalization in catalytic firing processes.

Short description of the project

The proposed project highlights the way different biodegradable materials can be capitalized with emphasis on agricultural, municipal and industrial residues, using anaerobic fermentation processes with biogas production. The project structures in an interdisciplinary manner lifecycle of degradable resources mentioned above, from the point of origin to the exploitation of obtained biogas using catalytic combustion. It will be used a two-pronged approach to capitalize biodegradable materials: theoretical, using mathematical models for determining the characteristics of the anaerobic fermentation process and experimental, through laboratory determinations to characterize the substrates and obtained biogas using combustion tests in order to identify the most suitable catalysts in this regard. The purpose of the project involves a novel contribution in a direction which is currently under development at national level by providing relevant information impacting the quality of life by increasing regional and local autonomy in the context of valorization the renewable energy resources. The degree of novelty for the project also involves developing an experimental pilot for testing liquid substrates in anaerobic fermentation processes, which can have further industrial applications.

Project implemented by

Politehnica University Timisoara,
Mechanical Engineering Faculty,
Department of Mechanical Machines Equipment and Transportation

Implementation period

01.10.2015 – 30.09.2017

Main activities:

- Establishing the substrates which will be further used in experimental determinations;
- Mathematical modeling;
- Experimental tests on existing installations;
- Catalytic elements synthesis for further use in biogas combustion processes;
- Tests over the optimization possibilities for biogas combustion using catalytic elements;
- Comparison of experimental and modeling determinations.

Results

- 2 papers published in ISI journals (Web of Knowledge);
- 2 papers published in BDI indexed journals;
- participation to at least 2 national/international conferences;
- publishing of a book or a book chapter with the obtained results.

Applicability and transferability of the results

The project underlines the need to develop new methods of valorization for the non-usable biodegradable part through interdisciplinary approach which has as a main purpose determining the exploitation possibilities for the residual materials which originate from agriculture or municipal /industrial environment through chemical conversion processes with impact on biogas production.
Through developing and application of models for determining the best residual material sorts which are to be used in anaerobic fermentation processes and their application at pilot scale, it can be open a new research direction relative to the used models for semi - industrial or industrial scale for solving, at least partially, the energetic demand from renewable sources.
This aspect can help in regards to increased degree of energetic independence at local and regional levels with impact onlife quality for the involved population of the respective areas from two points of view: reduced price for gas through input of renewable energy and increased work opportunities in case of developing respective installations in this purpose.

Financed through/by

Romanian National Authority for Scientific Research and Innovation, CNCS – UEFISCDI

Research Centre

MMUT / ICER

Research team

Cioablă Adrian Eugen – director;
Trif - Tordai Gavrilă – postdoctoral researcher;
Lelea Dorin – researcher;
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Țenchea Adrian – researcher;
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MITIGATION OF DECELERATED SWIRLING FLOW FROM CONICAL DIFFUSERS USING PULSATING WATER JET

Goal of the project:

The fundamental problem addressed in this project is studying a new control method of decelerated swirling flow. The main goal of this project is to evaluate numerically and experimentally the performance of a new flow control method with pulse water injection. The first goal of the project is to mitigate the low frequency plunging oscillations using axially-injected pulsation jets. The second goal is to minimize the injected discharge during this control. This project attempts to deliver answers to the following questions: Is the pulse water injection a valid control method from experimentally point of view? What is the pulse jet parameters which allow the mitigation/elimination of the VR and the maximum pressure recovery in the cone and what is the optimal jet's discharge value? Are there any technical and economical limits of this method? Which are the advantages (if any) of this method with respect to the previous ones (the jet and hydrodynamic feedback)? Which are the disadvantages (if any) of this method with respect to the previous ones (the jet and hydrodynamic feedback)? An existing test rig from Politehnica University of Timisoara is going to be used for experimental investigation of this method (Fig. 1).

Short description of the project:

The new control method consists in injecting a pulsating axial water jet in order to mitigate the low frequency plunging oscillations. The idea of using pulsating jets is yielded by the measured pressure's low-frequency oscillation in the conical diffusers of hydraulic turbines which are operated at part load. These regimes are imposed by the power network requirements. The fixed blade turbines e.g. Francis type, operating at part load present a high level of swirling flow at the inlet of draft tube. When swirling flow from draft tube is decelerating, it becomes unstable giving rise at helical vortex (or vortex rope). Vortex rope is the main cause for the occurrence of pressure fluctuations in draft tube of hydraulic turbines operating at part load. Mitigating the vortex rope phenomenon is an open problem for modern Francis hydraulic turbines. Numerous techniques have been examined for reducing these effects, with success varying widely. Two types of pressure fluctuations associated with the draft tube surge are identified in the literature. The first is an asynchronous pressure fluctuation due to the precession of the helical vortex around the axis of the draft tube. The second type is synchronous fluctuations who give rise to power fluctuations. Consequently, these low-frequency pressure oscillations will be mitigated using the pulsating axial jet control method.

Project implemented by

Politehnica University Timisoara, Research Center for Engineering of Systems with Complex Fluids

Implementation period:

01.10.2015-30.09.2017

Main activities:

1) Objective I: 3D numerical analysis of swirling flow using pulsating jet injection method,
2) Objective II: Manufacturing and implementing on the rig of Rotating Pulsating Jet Device,
3) Objective III: Experimental campaign for pulsating jet parameters optimization,
4) Objective IV: Validation of experimental vs. numerical data.

Results:

The results for 2016 are presented in the list of papers:
1. C. TANASA, T. CIOCAN, S. MUNTEAN and R. SUSAN-RESIGA, (2016), Numerical Assessment of Decelerated Swirling Flow with Vortex Rope from Conical Diffuser Using Pulsating Water Jet, 19th International Seminar on Hydropower Plants, Vienna, 09-11, November.
2. SUSAN-RESIGA Romeo-Florin, MUNTEAN Sebastian, TĂNASĂ Constantin, BOSIOC Ilie Alin, CIOCAN Tiberiu, POPESCU Constantin, (2016), ECHIPAMENT PENTRU CONTROLUL INSTABILITĂȚILOR CURGERILOR CU VÂRTEJ DIN DIFUZORUL CONIC AL TURBINELOR HIDRAULICE, patent application no. A0038/12.05.216 - in romanian.

Applicability and transferability of the results:

A new control method is promoted in this project which attempt to improve the flow control and mitigate the axial pressure pulsations revealed by previous investigations. The decelerated flow control using pulsating jets is a new idea. This new control method will mitigate the low frequency pressure pulsations. These plunging oscillations are dangerous due to the waves traveling along to hydraulic passage. This project will evaluate numerically and experimentally the performance of a new decelerated flow control method: using pulse water injection. Decelerated flow control is a problem experienced by hydraulic turbines when operating far from their best efficiency point as a request from energy market demands. Operating in such a regime (if even possible) causes severe vibrations, efficiency decrease, material fatigue, breaks blades etc. Implementation of a decelerated flow control system able to eliminate vibrations leads to maintenance and operation costs decrease. The method which will be tested on the experimental test rig will be proposed for using in real power plants from the national company SC Hidroelectrica SA Romania, which is partner in different contracts in the field of hydraulic machinery with our institution.

Financed through/by

Unitatea Executiva pentru Finantarea Invatamantului Superior, a Cercetarii Dezvoltarii si Inovarii UEFISCDI

Research Center

Research Center for Engineering of Systems with Complex Fluids

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5. Predoiu Ionut-Costinel, Student Doctorand
6. Mos Daniel, Student Masterand
7. Muntean, Sebastian, Cercetator Senior
8. Todiruta Mariana, Cercetator Senior
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INCREASING COMPETITIVENESS OF COLTERM BY OPTIMIZING VARIABLE SPEED CONTROL TECHNOLOGY OF LARGE POWER CENTRIFUGAL PUMPS FOR HEATING

Goal of the project

The objective of this project is to integrate the new modern assemblies pump-electric motor-converter with variable speed control technology in the transport network of the thermal energy from Timisoara and the efficient operation of the entire transport network of the thermal energy.

Short description of the project

The objectives of this project are the integration of the two modern assemblies in the transport network of the thermal energy from the city of Timisoara together with the efficient operation of the entire heating network. To achieve these objectives an experimental investigation will be carried out for the designated pumps from the transport system of the thermal energy from the two CET in order to obtain characteristic curves of operation.

Main activities

There are three main activities.
The first one is to determine a protocol for experimental investigation of centrifugal pumps and to apply it on a couple of pumps from the Laboratory of Hydraulic Machines.
The second one is to investigate the pumps from CET Centru and establish the best operating pattern for these pumps.
The third one is to investigate the pumps from CET Sud and establish the best operating pattern for these pumps.

Project implemented by:

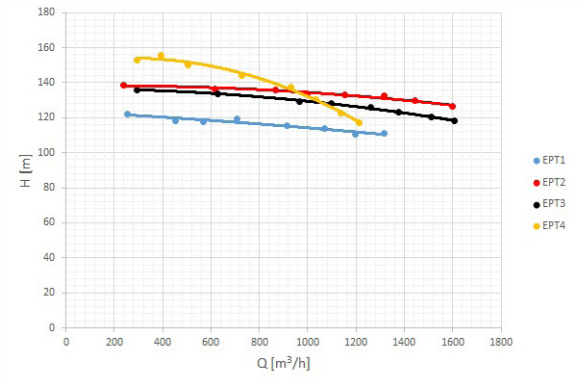
The project is implemented by a team from the Politehnica University Timișoara.

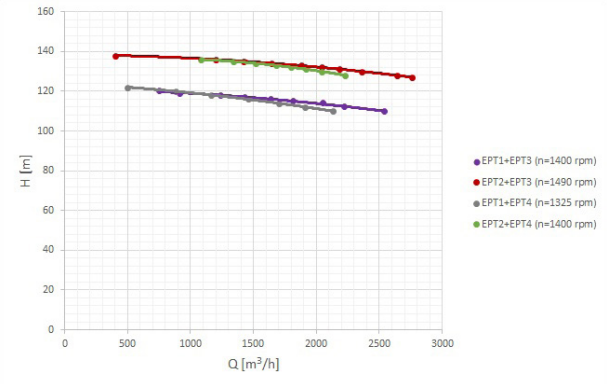
Implementation period

30/09/2016 - 30/09/2018

Results

The estimated results of this project are the operating patterns of the centrifugal pumps from CET Centru and CET Sud and the best efficient operating pattern of these pumps. Until now, the pumps from CET Centru were investigated and the results are presented in the next three figures. In the first figure, we have the operating curves of the four centrifugal pumps from CET Centre. In the second figure, we have the best operating pattern for these four pumps.





Applicability and transferability of the results:

The best operating patterns of the centrifugal pumps from CET Centru and CET Sud will help Colterm to operate these pump at best efficiency in order to supply the necessary domestic hot water and thermal energy for the citizens of Timisoara. By doing this, Colterm will optimize the cost with electric energy.

Financed through/by

CNCS – UEFISCDI, project number 69BG/2016/, project code PN-III-P2-2.1-BG-2016-0190

Research Center

Research Centre for Complex Fluid Systems Engineering

Research team

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IONOSPHERIC PROPAGATION PREDICTIONS AND WIDEBAND COMMUNICATIONS USING HF SDR SENSORS FOR INFORMATIONAL SUPPORT IN EMERGENCY SITUATIONS IN ROMANIA

Goal of the project

The project aims to implement software and hardware solutions that integrate ionospheric sounding algorithms in a network of SDR (Software Defined Radio) sensors in order to develop and validate a HF (High Frequency) ionospheric prediction model for the territory of Romania.

Short description of the project

The project targets a systemic approach of the communication network through the implementation, development and integration of recent technological solutions from the perspective of providing information support for the management of interventions in disaster areas where communication infrastructure does not exist or is damaged. Project results can be applied not only in the rapid resolution of remote communications in emergency situations, but also can be extended to other applications in the HF communications range, such as encrypted data communication links for the government or the military.

Project implemented by:

- Land Forces Academy "Nicolae Bălcescu", Sibiu - coordinator
- Interactive Systems & Business Consulting, Bucharest - partner
- Politehnica University Timişoara - partner
- Technical University of Cluj-Napoca - partner

Implementation period

21.11.2014 - 30.09.2017

Main activities

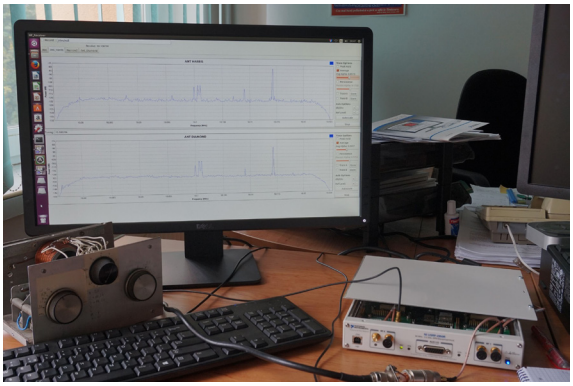
- Building a SDR sensor network for ionospheric sounding
- Elaboration of an application for HF propagation predictions in Romania.
- Development of broadband HF communications by the implementation of adaptive systems

HF antenna

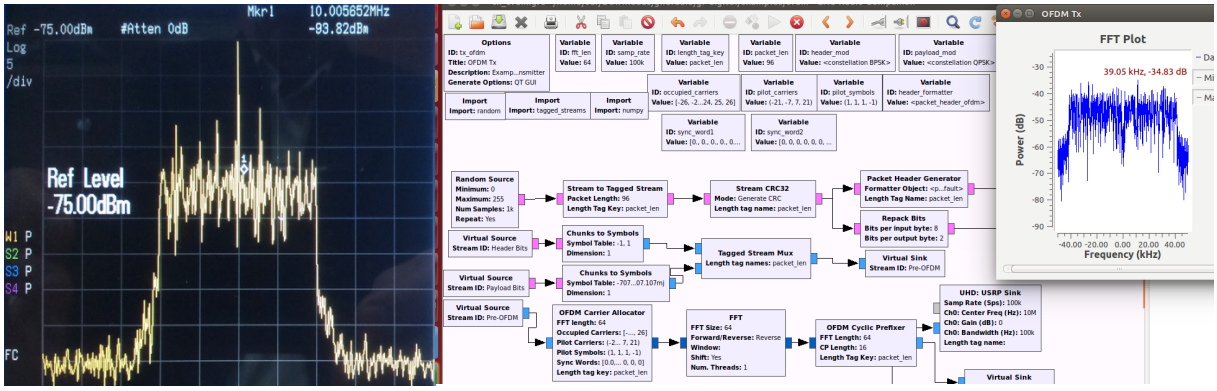
Results

The main deliverables of the project are:

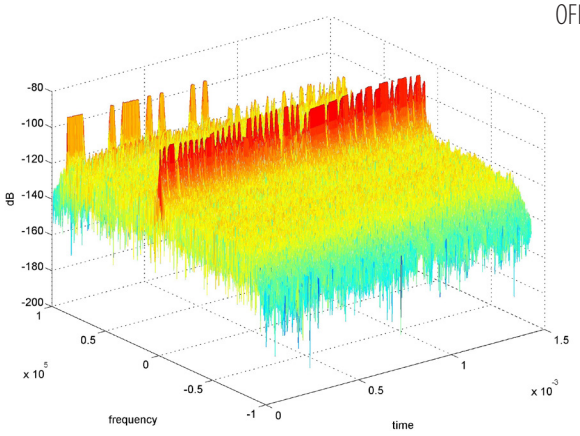
- an ionospheric model which is specific for Eastern Europe;
- algorithms for the automatic identification and classification of waveforms in order to increase the transfer rate and to implement techniques for dynamically accessing the HF resources;
- SDR solutions for local monitoring and collaborative spectrum sensing in the HF range;
- a HF radio network on the territory of Romania which allows high transfer rates in collaborative environments, by automatically adapting to specific conditions of ionospheric propagation at high angles of elevation.



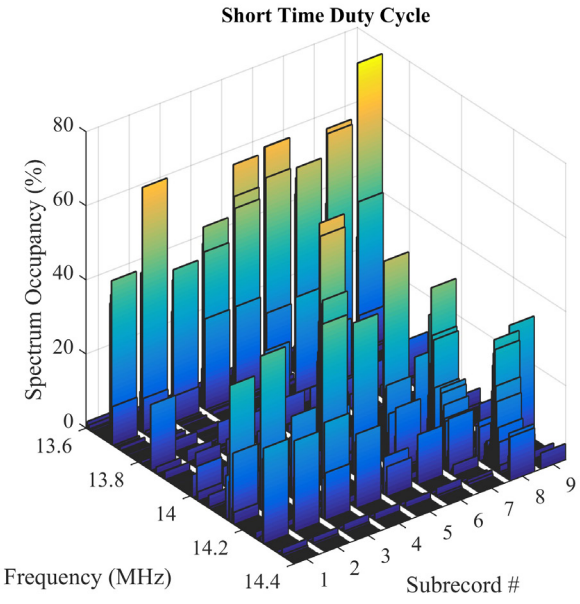
Experimental setup



OFDM signal



Time-Frequency representation of the HF signal



Spectrum Occupancy

Applicability and transferability of the results

- creating an integrated software application for HF propagation predictions adapted to the propagation particularities of our country
- implementing the ionospheric measurement capability for HF radio stations with SDR architecture
- measurement and modeling of Spectrum Occupancy in the HF range
- implementing algorithms for the adaptation of broadband waveforms to the ionospheric channel status
- implementing an integrated system for monitoring the ionosphere

Financed through/by

PN-II-PT-PCCA-2013-4

Research Centre

ICER

Research team

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AFFORDABLE AUTONOMOUS UNDERWATER VEHICLE (AUV) FOR SEARCH, INSPECTION AND MAINTENANCE OPERATIONS IN TURBID UNDERWATER

Goal of the project:

Developing an underwater enhancing technique that can work in real-time for affordable Autonomous Underwater Vehicle (AUV)

Short description of the project:

Autonomous Underwater Vehicles (AUVs) are devices able to follow a predefined route or is computing and adjusting the route as a result of sensor measurements. They were developed and used successfully on various applications; such as oceanographic surveys, bathymetric measurements, underwater maintenance and inspections activities (e.g. of the hydroelectric dams, bridges, sea wind turbines and oil sea platforms structure). Taking advantage of the latest advances in hardware and software, an ever-increasing number of underwater studies rely on AUVs that offer increased operational range and reduce potential hazards compared to classical methods involving divers or manned submersibles.

However, the existing AUVs performances are currently very limited due to the poor underwater visibility. In general the existing restoration techniques are too computationally expensive for AUVs. This project proposes a radically novel paradigm that provides the basis for more direct, interactive and efficient underwater studies, while reducing the associated costs. The technologies developed in the context of this project will allow the scientists to directly study, in an immersive way and in real-time, the environment surveyed by the AUVs, while allowing remotely interacting with the vehicle in a natural and intuitive manner.

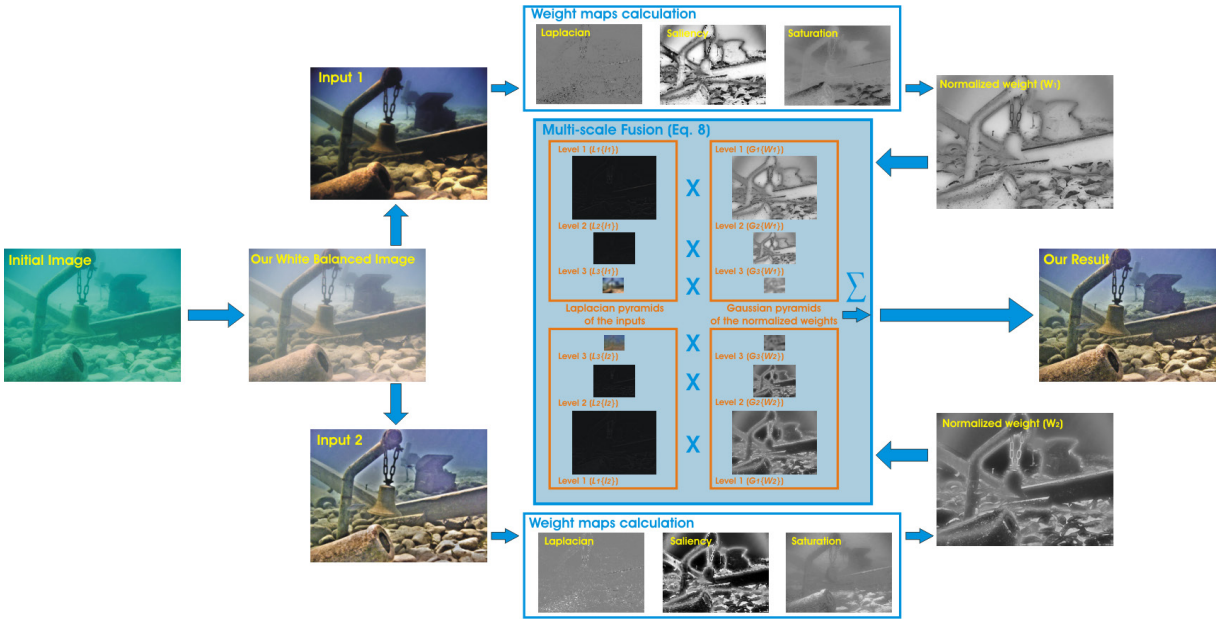

Figure 1: Overview of the proposed method.

Project implemented by

University Politehnica Timisoara, Romania

Implementation period:

January 2017- June 2018

Main activities:

The main activities of the project:
- identification of specific requirements of underwater imaging technique to be implemented on a specific hardware platform;
- design of an exploration path for specific functionalities;
- designing and recording of specific underwater image scenarios;
- implementation of the underwater imaging technique;
- optimize and integrate the underwater enhancing technique;
- publish the results;

Results:

- Developing an effective underwater enhancing technique
- 2 WOS/ISI papers and 1 BDI paper
- 1 ISI journal (IEEE Transactions on Image Processing, Q1, impact factor 4.8)

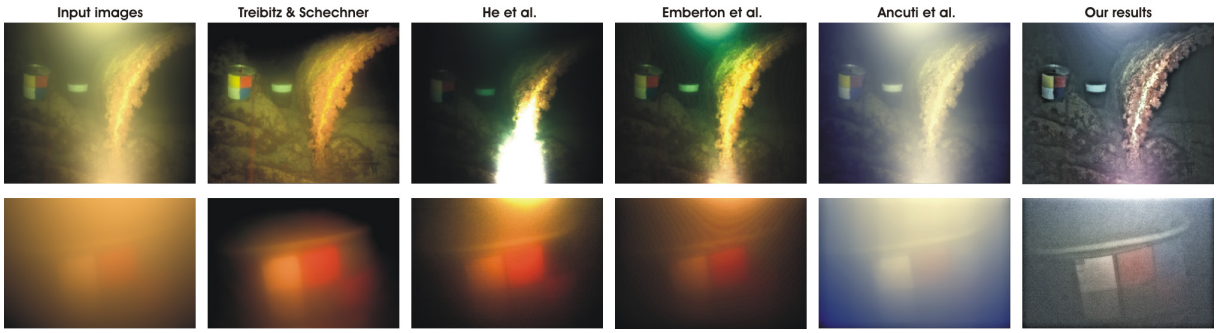

Figure 2: Underwater dehazing of extreme scenes characterized by non-uniform illumination conditions.
Our method performs better than earlier approaches of Treibitz and Schechner, He et al., Emberton et al. and Ancuti et al

Applicability and transferability of the results:

The outcome of this project may be applied in the field of underwater imaging and in the AUV's industry.

Financed through/by

Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Bucharest, Romania

Research Center

Research Center of Intelligent Systems

Research team

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TRANSFER OF KNOWLEDGE FOR FATIGUE STRENGTH EVALUATION OF STEERING WHEELS SKELETON

Goal of the project

- Interconnection of the expertise of the project team from University Politehnica Timisoara with the quality assurance requirements of TRW Company for the steering wheels.
- Transfer of knowledge regarding the static and dynamic characterization of Magnesium alloys.
- Intensification of the cooperation between University Politehnica Timisoara and TRW Company for understanding of mechanical behavior and for the implementation of a methodology to assess the durability of steering wheel skeletons.

Short description of the project

The project propose a transfer of knowledge from the experts from University Politehnica Timisoara in order to implement the methodology to determine the fatigue strength of steering wheel skeleton.

Project implemented by:

Universitatea Politehnica Timisoara and
TRW AUTOMOTIVE SAFETY SYSTEMS SRL (Economic partner)

Implementation period

30/09/2016-29/09/2018

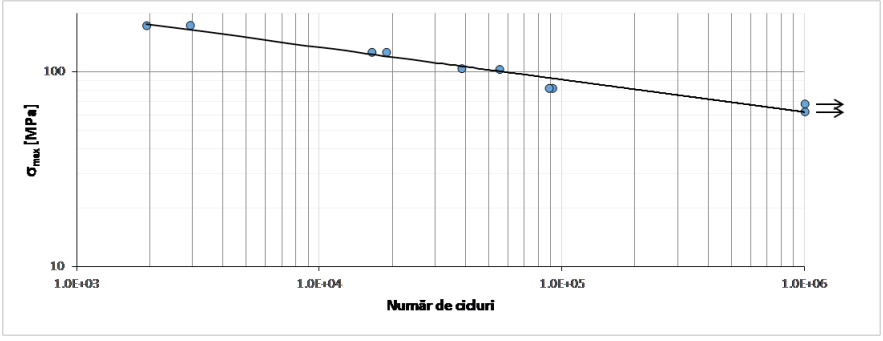
Main activities

- Interconnection of the expertise of the project team from University Politehnica Timisoara with the quality assurance requirements of TRW Company for the steering wheels.
- Mechanical characterization and determination of static and dynamic properties of Magnesium alloys used for steering wheels.
- Elaboration of material models for Magnesium alloy AM50. Numerical estimation of durability of steering wheel skeletons.
- Practical training of master students from University Politehnica Timisoara on modern equipment of TRW company.

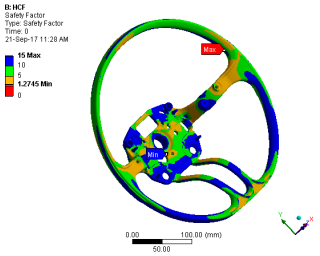
Results

The TRW company will implement a methodology to evaluate the fatigue strength for the steering wheels skeleton made of Magnesium alloys and will be able to perform in-house tests at the Timisoara branch.
After the project implementation the TRW company will receive a methodology to assess the static and dynamic characteristics of Magnesium alloys. Also, will be developed the methodology to assess the fatigue strength of steering wheels skeletons. Very important results are represented by fatigue curves for Magnesium alloy, which could be useful in the design stage to perform numerical durability studies.

Participation at two international conferences ARTENS - Sibiu 2016 and ICSID - Dubrovnik 2016. Publication of the paper FATIGUE ANALYSIS OF MAGNESIUM ALLOYS COMPONENTS FOR CAR INDUSTRY, Authors L. Marsavina, L. Rusu, D. Serban, R. Negru, A. Cernescu, ACTA UIVERSITATIS CIBINIENSIS – TECHNICAL SERIES Vol. LXIX 2017, p. 47-51



Fatigue curve on tensile loading for AM50 Magnesium alloy



Safety factor under fatigue loading

Applicability and transferability of the results:

The TRW company will implement a methodology to evaluate the fatigue strength for the steering wheels skeleton made of Magnesium alloys and will be able to perform in-house tests at the Timisoara branch. After the project implementation the TRW company will receive a methodology to assess the static and dynamic characteristics of Magnesium alloys. Also, will be developed the methodology to assess the fatigue strength of steering wheels skeletons. Very important results are represented by fatigue curves for Magnesium alloy, which could be useful in the design stage to perform numerical durability studies.

Financed through/by

Bridge Grant PN-III-P2-2.1-BG-2016-0060, Contract 89BG/2016 89 by Romanian Ministry of Research trough UEFISCDI

Research Center

ICER

Research team

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TRANSFER OF KNOWLEDGE FOR DASHBOARD AND HEAD-UP DISPLAY OPTIMIZATION THROUGH TESTING AND MODELLING OF ADVANCED MATERIALS

Goal of the project

The goal of the project is the determination of strain rate and temperature variation in mechanical properties of several advanced materials used in vehicle instrument clusters and Head-Up displays. With the gathered experimental data, non-linear material models are to be developed for the use in finite element analysis of various components during the product design stage.

Short description of the project

This project deals with the mechanical characterization and numerical simulations of advanced materials used in the automotive industry

Project implemented by:

This project is implemented by Universitatea Politehnica Timișoara with the support of Continental Automotive Romania.

Implementation period

01/10/2016 – 31/03/2018

Main activities

01. Determination of the mechanical and thermal properties of the investigated materials
- Static tests (determination of the influence of strain rate and temperature)
- Fatigue tests
- DMA tests

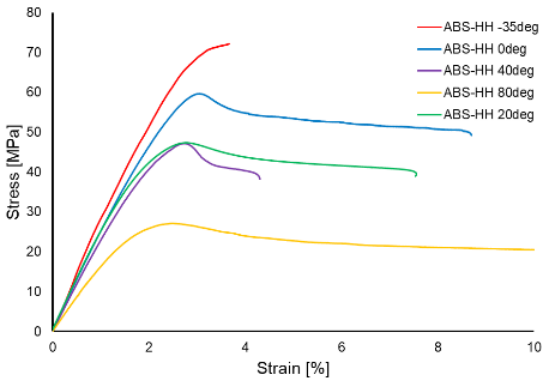
02. Development and evaluation of constitutive models used in simulations
- Development of constitutive models based on the gathered experimental data
- Evaluation of the developed material modes through experiment replication

03. Implementation of the constitutive models in product simulations
- Analysis of simulation results and comparison with experimental data
- Identification of optimal models from an accuracy and simulation time standpoint

04. Development of procedures for facilitating the introduction of new materials
- Establishment of a test benchmarks
- Proposal of easy-to-calibrate material models for simulating new materials

Results

In this project, the experimental procedures determined the mechanical properties of 5 materials. The strain rate influence on the tensile and flexural properties was investigated in the range of 2 – 200 mm/min test speed, showing a noticeable influence on the strength and stiffness of the materials. The materials were also tested in a temperature range of -35 ºC to 80 ºC, showing significant variation is strength, stiffness and also in behavior (Figure 1).



Other experimental procedures included DMA tests and the determination of the Poisson ratio.

The gathered experimental data was used to calibrate elastic-plastic material models for finite element analysis simulations. Temperature and strain-rate dependency was integrated in the models, the material evaluation showing good agreement with the experimental results.

Applicability and transferability of the results:

The aim of the Bridge Grant was to directly aid companies through the transfer of knowledge, all results being delivered to the project partner:

- The experimental results were supplied to Continental Automotive Romania, the data being used in the material selection process in product design.
- The proposed material models will be used by Continental Automotive Romania in numerical analyses of newly designed components.

Financed through/by

UEFISCDI

Research Center

Ștefan Nădășan Laboratory

Research team

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CENTRALIZING AND OPTIMIZING SCADA IN THE WATER SECTOR (CASCADA)

Goal of the project

The knowledge transfer to Aquatim through software and hardware modules and strategies for centralizing and optimizing SCADA for the water sector.

Short description of the project

The general purpose of CASCADA is the knowledge transfer to the economic operator through software and hardware modules and strategies to solve stated problems in centralizing and optimizing SCADA for the water sector. The project proposes the ICOM module (Interface, Conversion, Optimization, Modularity) as instrument in solving both interfacing and protocol conversion problems and the development of non-invasive optimization modules of controlling groups of objectives already in function in the water sector. Also, in order to improve effectiveness, the project addresses the IGSS SCADA implementation strategy in Aquatim control center and the existing communication system. CASCADA wants to train Aquatim in SCADA/automation/communications new technologies and to practically apply the concepts in a SCADA analysis of three existing objectives of the operator.

Project implemented by

University Politehnica Timisoara

Implementation period

30.09.2016-30.09.2018

Main activities:

The activities are foreseen to implement the following three objectives:
1) Realizing and testing the ICOM module;
2) Optimizing the IGSS control center;
3) Direct knowledge transfer in new technologies.

Results

CASCADA, through the ICOM module will solve the SCADA integrability problems of the economic operator, respectively will provide an instrument, independent of local equipment and SCADA solutions, to answer integrability and functioning optimization issues for groups of interdependent objects as technological flow but independent regarding their implementations. Therefore, due to SCADA correlations of groups of objects (integrations on higher SCADA levels and creating control algorithms for group of objects), the economic operator's systems will be more stable and efficient, respectively the impact of the incidents will be reduced.
Optimizing the IGSS control center will provide the possibility to maximally use the resources available through licensing, an increased communication speed through systematizing the internal Aquatim network, respectively an adequate web based access conferred by the WebNavIGSS module.
CASCADA will impact also the quality of the future investments of the economic operator through opening perspectives to new technologies and optimal solutions, with increased efficiency and reduced costs.
The implemented activities will strengthen the entrepreneurial abilities of researchers and the connection between the academic environment and the industry requirements.

Applicability and transferability of the results

As a bridge grant, the project is strongly industry oriented, with significant practical value and focused on the knowledge transfer to an economic operator.

Financed through/by

UEFISCDI

Research Centre

ICER – Renewable energy research institute

Research team

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Teodor HUPLE
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MESSAGE PASSING ITERATIVE DECODERS BASED ON IMPRECISE ARITHMETIC FOR MULTI-OBJECTIVE POWER-AREA-DELAY OPTIMIZATION

Goal of the project

The DIAMOND project proposes to exploit the robustness of modern decoders to arithmetic inaccuracies, for improving their latency and power consumption. The project focuses on Low-Density Parity-Check (LDPC) codes widely used in modern communication systems, and targets the design of message-passing iterative decoders using imprecise arithmetic units. We aim at harnessing the inaccuracies produced by imprecise computational units, while benefiting of their significant reductions in area, latency and power consumption.

Short description of the project

The project investigates the possibility of optimizing LDPC decoding architectures by employing imprecise and approximate techniques at different levels: message representation, processing unit and architecture.

Project implemented by

- Universitatea Politehnica Timisoara (UPT) – Romanian partner
- CEA-LETI, Grenoble – French coordinator partner
- ETIS Laboratory – French partner

Implementation period

March 2014 – March 2017

Main activities:

DIAMOND project have analyzed the impact of the introducing impreciseness and approximations in LDPC decoding architecture on the decoding performance, cost and throughput. The main activities involved:

1. Development of LDPC decoding techniques using imprecise message representation
2. Analysis and development of imprecise processing units
3. Development of imprecise stopping criteria for layered decoding
4. Development of proof-of-concept decoders using the imprecise techniques at different levels.

Results

The main results of the DIAMOND project include:

1. Imprecise message representation techniques – these include the development of the modified offset min-sum (MOMS) LDPC decoding, as well as the non-subjective finite alphabet iterative decoding of LDPC codes.
2. Imprecise processing units – the main developments have consisted in a novel check node unit using one-hot representation of messages, and a novel version of self-correcting min-sum (SCMS), that allows the implementation of this SCMS based LDPC decoder with a similar cost as the Min-Sum based ones.
3. Imprecise early termination criteria for layered LDPC decoders

In order to provide a wide range of proof-of-concept decoding architectures, for which a wide range of architecture and code parameters can be analyzed, an integrated environment for the architecture generation, verification and implementation – TEDI – has been developed.

Applicability and transferability of the results

The DIAMOND project aims at optimizing LDPC decoding architectures used for forward error correction in both wireless communications and data storage. Several steps for economic and industrial results dissemination have been undertaken. On one hand, a simplified version of the LDPC decoding architecture generator has been made publicly available on the webpage dbyaclick.cs.upt.ro . On the other hand, the proposed stopping criteria for layered LDPC decoding architectures has been considered for a joint patent application between the project partners.

Financed through/by

UEFISCDI – Romanian funding agency
ANR – French funding agency
Romanian project number: PN-II-ID-JRP-RO-FR-2012-0109

Research Centre

Research Centre in Computing and Information Technology – CCCTI

Research team

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DIVIDEND - DISTRIBUTED HETEROGENEOUS VERTICALLY INTEGRATED ENERGY EFFICIENT DATA CENTRES

Goal of the project

DIVIDEND aims to optimize heterogeneous data centers, combining CPUs, GPUs, and task-specific accelerators, as a unified entity to the application developer and let the runtime optimize the utilization of the system resources during task execution. DIVIDEND embraces heterogeneity to dramatically lower the energy per task through extensive hardware specialization while maintaining the ease of programmability of a homogeneous architecture.

Short description of the project

DIVIDEND provides cross layer energy monitoring and management in data centers that use heteregenous CPU, GPU and FPGA based processing. We aim to provide energy optimization using a vertical based integration from different abstraction layers: hardware, operating system, compiler and application.

Project implemented by

- University of Edinburgh – Coordinator
- University of Lancaster
- Queens University of Belfast
- Ecole Polytechnique Federale de Lausanne
- Universitatea Politehnica Timisoara
- INRIA Paris,
- Advanced Micro Devices, Paris

Implementation period

May 2015 – May 2017

Main activities:

The main activities performed in UPT are related to the development and integration of energy monitoring of dedicated FPGA accelerators into the Distributed Heterogeneous System Architecture (DHSA) concept. The UPT research represents the first approach to use the FPGA accelerators in hybrid architecture with full access to the system shared memory, as well as complete queuing support for DHSA. We aim at providing efficient acceleration for irregular parallel application using the proposed approach.

Results

The DIVIDEND project has provided a complete integration of FPGA based application accelerators into the DHSA systems, by offering the required hardware, as well as driver and operation system level support. Furthermore, energy accounting for dedicated FPGA hardware accelerators for distributed applications is offered. Therefore, an energy aware FPGA acceleration in distributed HSA based heterogeneous CPU-GPU-FPGA systems has been developed.

Applicability and transferability of the results

The DIVIDEND project developed the first approach that provides an energy cost for an application that has been executed in the distributed data center, composed of a heterogeneous computation platform consisting of CPUs, GPUs, or FPGAs. Therefore, for each user which runs applications on a data-center, a cost for the execution of each task can be offered. Therefore, the DIVIDEND project offers an energy aware application execution framework on distributed data-centers.

Financed through/by

CHIST-ERA NR 5/2015

Research Centre

Research Centre in Computing and Information Technology – CCCTI

Research team

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ECO-EFFICIENT RECOVERY OF WASTES FROM HOT DIP GALVANIZING PROCESS AS ANIONIC CLAYS APPLICABLE FOR REMOVAL OF UNDESIRABLE COMPOUNDS FROM WATER

Goal of the project

The main objective of the project is the synthesis of anionic clays (layered double hydroxides) from wastes of hot dip galvanizing process (zinc ash and sludge from wastewater treatment) and the utilization of these materials in removal processes (adsorption or photocatalysis) of undesirable compounds from water (i.e. phenols, dyes, chromate). Another objective is to gain significant research experience for the project team.

Short description of the project

By treatment of industrial wastes some layered double hydroxides (LDH) will be prepared. The correlation between the chemical characteristics of precursors of LDH obtained from wastes and the performances of LDHs in removal processes of undesirable compounds from water will be clarified.

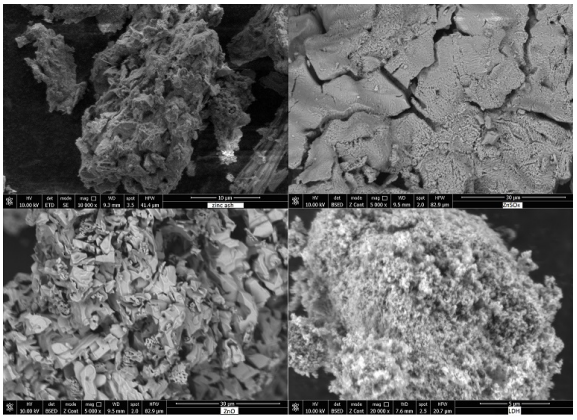

Figure 1. SEM images of zinc ash and product obtained after zinc ash treatment ($ZnSO_4$, ZnO and LDH)

Project implemented by

Faculty of Industrial Chemistry and Environmental Engineering

Implementation period

01.10.2015 – 30.09.2017

Main activities:

1. The influence of the working parameters of wastes treatment process on the chemical characteristic of the obtained metal solutions;
2. The influence of the chemical characteristics of solution precursors on the morphological and surface properties of the synthesized LDH;
3. The performances of the synthesized LDH in the sorption and photocatalytic processes for removal of undesirable compounds from water.

Results

1. Method for valuable metal recovery from wastes of hot dip galvanizing process.
2. New method for anionic clay synthesis from metal ions recovered from wastes of hot dip galvanizing process.
3. Method for removal of undesirable compounds from water by anionic clays synthesized from wastes of a "dirty industry".

Applicability and transferability of the results

By applying this approach, the wastes of a "dirty industry" (hot dip galvanizing process) are treated and a valuable product is added, keeping in mind that the anionic clays have multiple utilizations at industrial scale as plastic additives, as flame retardant and as anions scavengers. The project has an interdisciplinary character presenting an integrated concept of industrial wastes treatment and waters depollution.

Financed through/by

Romanian National Authority for Scientific Research and Innovation, CNCS - UEFISCDI

Research Centre

Research Institute for Renewable Energy

Research team

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SYNERGIC GREEN TECHNOLOGIES FOR TREATMENT OF HEXAVALENT CHROMIUM POLLUTED WATERS

Goal of the project

The first major objective of this project will be to study the influence of co-presence of sand, MnO_2 and sand coated with manganese oxides on Cr(VI) efficiency of removal with metallic iron. The second major objective of this project is to study the immobilization of exhausted reactive mixtures containing Fe, Cr, sand and MnO_2 in vitreous matrices. The Cr, Fe and Mn immobilization in the glass matrix will be analyzed in order to convert the resulting glasses into marketable glazes or bulk glass products.

Short description of the project

The proposed theme is integrated in the thematic area of water and wastewater treatment, with the aim of water reuse, waste recovery and protection of environment quality.

Project implemented by

University Politehnica Timisoara

Implementation period

01.10.2015-30.09.2017

Main activities:

1. Batch treatability experiments. Will be performed using a Berzelius flask containing Cr(VI) solution. Determined amounts of reactive materials are added to the solution and flask contents will be mixed continuously. Aliquots will be periodically extracted and analyzed.
2. Continuous long term column treatability experiments. Will be performed using an experimental setup comprising: columns with reactive material filling; peristaltic pump used to pass the Cr(VI) aqueous solution through the column; storage tank for the Cr(VI) solution. The Cr(VI) solution will be passed through the column packed with reactive material filling. Column effluent samples will be withdrawn at regular time intervals and analyzed.
3. Experiments regarding the synthesis of glasses from wastes. The exhausted reactive materials will be mixed with glass powders and borax and then melted in an electric furnace. In order to obtain bulk glass products the melt is press-quenched between two stainless steel blocks and annealed to remove stress. The granular frits are obtained after pouring the melts in cold water. The glaze slurry is prepared using the obtained frits (95%) and kaolin (5%) as suspension material. The terracotta plates glazed by immersion are dried and then fired at 980°C for 30 min. For the porous glass synthesis a foaming agent (SiC) was added together with the waste glass powder and the exhausted reactive mixtures. The raw materials are mixed together and then uniaxial pressed into cylindrical samples. The samples, dried at 80°C for 12 hours are treated at 900°C for 10 minutes.

Results

The assessment of sand co-presence on Cr(VI) removal with metallic iron.
The assessment of MnO_2 co-presence on Cr(VI) removal with metallic iron.
The assessment of MnO_2 and sand mixtures co-presence on Cr(VI) removal with metallic iron
The immobilization of exhausted reactive mixtures containing sand, Fe and Cr in vitreous matrices.

Applicability and transferability of the results

Treatment of waters polluted with Cr(VI).
Conversion of wastes into marketable glazes or bulk glass products

Financed through/by

Project PNII-RU-TE-2014-4-0508 No. 129/1/10/2015, Synergic green technologies for treatment of hexavalent chromium polluted waters. Total funding: 550000 RON

Research Centre

ICER

Research team

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EXPERIMENTAL MODEL FOR AN AUTOMATIC CAPACITIVE COMPENSATOR DESIGNED FOR IMPROVING THE POWER FACTOR AND FOR LOAD BALANCING IN LOW-VOLTAGE ELECTRICITY DISTRIBUTION NETWORKS - CAEREDJT

Goal of the project

The project is intended to finance industrial research activities, needed to put in practice under the form of an experimental model of research findings of a group of academics from UPT, concerning the network load balancing electric phase through cross unbalanced capacitive compensation. In electrical networks, inductive load variation implies variation of the capacitive compensation, thus the need for building an unbalanced capacitive automatic compensator, to track the load variation.

Short description of the project

The automatically unbalanced capacitive compensator proposed by this project is an innovative product, so achieving a functional experimental model involves overcoming a number of scientific and technical challenges, the most important being: control and single-phase switching of the capacitor batteries steps, the construction algorithm and implementation of a programming language for PLC process control, process optimization for automatic compensation.

Project implemented by

- Politehnica University of Timisoara– Lead partner
- S.C. ICPE S.A. Bucharest – Project partner

Implementation period

01.07.2014 - 30.09.2017

Main activities

1. Conducting studies and analysis on the alternative constructive solutions and developing the technical documentation for the construction of the experimental model.
2. Manufacturing of the experimental model and the analysis, control and monitoring systems.
3. Testing the model and proving its functionality and its utility
4. Dissemination of results and protect the intellectual property rights.

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation - UEFISCDI

Applicability and transferability of the results

The results of the project are useful for unbalanced electrical loads supplied at low voltage level, and also for the Distribution system operator (DSO).

Results

- The main outcome of the project will be a functional experimental model and its documentation of implementation for a capacitive compensator designed to improve power factor and load balancing in networks of low voltage power distribution.
- It will underpin the design and construction in a later stage, of a prototype of a capacitive automatically balance high power compensator (tens of kVA) for increasing network performance of low-voltage power distribution and utilization facilities connected to it, by reducing reactive power flow and load balancing.
- The results of the research will be disseminated in scientific papers in professional journals or communication conferences.
- New technical solutions brought by this automatic capacitive compensator, as regard to the structure, order, sizing, automatic control algorithm, will be the subject of intellectual property protection activities.

Research Centre

Analysis and Optimization of the Electrical Power Systems Regimes

Research team

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NOVEL TECHNIQUE TO ENHANCE THE SECURING LEVEL OF SECURITY PAPER USING THE SUPERPARAMAGNETIC FINGERPRINT OF MAGNETIC NANOPARTICLE DISPERSIONS - NANOMAGSECURITYPAPER

Goal of the project

The continuous diversification of the paper securing techniques is one of the most important ways to erect fences against forgery attempts. The project aims to expand the diversity of high tech means for paper securing. The general objective of the project is to elaborate a new paper securing technique based on the superparamagnetic fingerprint of magnetic nanoparticles made of oxide compounds

Short description of the project

The objective is to elaborate a new paper securing technique based on the superparamagnetic fingerprint of the magnetic nanoparticles.

Project implemented by

- Romanian Academy – Timisoara Branch (Project Coordinator)
- SC CEPROHART SA (Partner 1)
- SC ROSEAL SA Odorheiu Secuiesc (Partner 2
- SC Datronic – NCIP SRL (Partner 3)
- National Institute of R&D for Izotopic and Molecular Technologies Cluj-Napoca (Partner 4)
- Politehnica University of Timisoara (Partner 5).

Implementation period

July 1, 2014 – September 30, 2017

Main activities

- elaboration of superparamagnetic paper assortments with
  - low security level, using poly-disperse magnetic nanoparticles
  - high security level, using bi-disperse magnetic nanoparticles
  - white color, using core-shell (core/magnetic, shell/polymer) particles
- elaboration and testing the authentication method by static and dynamic magnetometry

Results

- methods for synthesis and characterization of oxide magnetic nanocomposites
- methods for elaboration and validation of magnetic loaded papers
- first instance validation of magnetic loaded papers

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI

Applicability and transferability of the results

The new method of securing paper using the superparamagnetic nanoparticles can be transferred to SC Ceprohart SA Braila. The transfer will contribute to:

- diversification of the product made in the national paper industry with simple brown paper secure and secure complex white paper,
- orientation of national industry to obtain a special paper grade with high complexity,
- increase the security level of specialty papers, difficult to fake on the internal market
- reduce the imports of security paper
- increase output and thus sales of security paper from Ceprohart.

Research centre

Research Centre for Engineering of Systems with Complex Fluids – Laboratory of Rheology and Magnetometry, from Politehnica University of Timisoara.
URL: http://mh.mec.upt.ro/ccisfc/

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MAGNETIC NANOFLUID ROTATING SEAL SYSTEMS FOR HIGH PERIPHERAL SPEEDS - HISPEED NANO MAG SEAL

Goal of the project

The project technical objective is to achieve at experimental model scale new leakage-free MNF sealing systems for high peripheral speeds (up to 30 – 70 $m \cdot s^{-1}$) in the sealing area, designed to equip gas turbo-compressors.

Short description of the project

The project proposes the development of seals with magnetic nanofluid (MNF), which has significant advantages compared to conventional mechanical seals: hermetic sealing, exceptionally long lasting operation without intervention (5 years), minimal wear (only viscous friction), virtually zero contamination, optimal torque transmission, wide operating range (10^{-8} mbar - 10 bar), relatively simple and cost efficient execution.

Project implemented by

- SC ROSEAL SA Odorheiu Secuiesc (Project coordinator)
- Romanian Academy – Timisoara Branch (Partner 1)
- National Institute of R&D for Izotopic and Molecular Technologies Cluj-Napoca, Politehnica University of Timisoara (Partner 2)
- Politehnica University of Timisoara (Partner 3)
- Romanina Research and Development Institue for Gas Turbines – COMOTI Bucharest (Partner 4)

Implementation period

July 1, 2014 – September 30, 2017

Main activities:

- laboratory and micropilot scale synthesis of magnetic nanofluids with carboxylic stabilizers and magnetizations between 400-1000 G
- conception, design and implementation of new experimental models of sealing systems with magnetic nanofluid for high peripheral speeds
- testing and performance evaluation of new experimental models sealing systems with magnetic nanofluid, designed for high peripheral speeds

Results

- methods for synthesis and characterization of high magnetization nanofluids with carboxylic stabilizers
- experimental models for new sealing systems
- experimental models for sealing systems – innovative version with magnetic nanofluids with carboxylic stabilization

Applicability and transferability of the results

The expected results will facilitate design and low cost industrial scale production of an original sealing system with stable MNF at high temperatures (160 – 180 °C), for high peripheral speeds (up to 30 – 70 $m \cdot s^{-1}$) in the sealing gap. They have some important advantages compared to conventional mechanical seals: hermetic sealing, high reliability, relatively simple construction, low execution cost. These performances indicate the market towards ROSEAL Co. is heading, namely the gas turbo-compressors in fertilizer and petroleum refining industry.

Financed through/by

Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) .

Research centre

Research Centre for Engineering of Systems with Complex Fluids – Laboratory of Rheology and Magnetometry, from Politehnica University of Timisoara.
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DEVELOPMENT OF ECO-FRIENDLY COMPOSITE MATERIALS BASED ON GEOPOLYMER MATRIX AND REINFORCED WITH WASTE FIBRES

Goal of the project

The project is an answer for a specific challenge regarding waste management, recycling and urban mining. The goal of the project is to prepare a broad spectra of advanced and progressive new composite materials based geopolymer matrices and reinforced with natural waste fibres. The application of these new materials will be the construction industry with a high potential of commercial utilization and potential replacement of conventional materials.

Short description of the project

This project deals with the development of new composite materials for construction industry, based on waste products.

Project implemented by:

Project coordinator: Cracow University of Technology.
Partners: Nigde University Turkey, Pontificia Universidad Católica del Peru, Riga Technical University Latvia, Babeș-Bolyai University, Catholic University of Uruguay Damas Antonio Larrañaga, Politehnica University of Timișoara.

Implementation period

02/01/2017 – 31/12/2019

Main activities

- WP1. The selection of waste materials for hydrothermal alkalization and therefore to be turned into new materials based on geopolymer matrix for construction applications
- WP2. The selection of waste materials (natural fibres) as a fillers and therefore turned into new composites for construction application
- WP3. Optimization of properties using computer methods for the new materials and structural elements
- WP4. The research into the application of new materials – comparison of the functional properties of the materials
- WP5. Analysis of practical applications of new materials for construction application and testing prototype components in laboratory as well as validated it in relevant environment

Results

The year 2017 had deadlines for the first two Work Packages.
WP1, coordinated by Nigde University, dealt with the identification of waste materials for the composite material matrices. Each participating partner performed a survey of possible waste material candidates available in their region (recycled clay bricks and volcanic ash in Peru, fly ash in Turkey, Argentina and Romania, paper mill sludge and rice husk ash in Uruguay and granulated rubber from waste tyres in Poland).

WP2, coordinated by Babeș-Bolyai University, dealt with the identification of waste natural fibres as reinforcements for the composites. As with WP1, each participating partner proposed waste materials available in their region (mostly hemp and flax fibres).

Applicability and transferability of the results:

The new composite materials that will be developed in this project will be tested and their properties compared with conventional construction materials. If the mechanical and thermal behaviour is comparable between the two categories, the newly developed materials will be proposed for replacing traditional materials in each specific region where the waste products are available.

Financed through/by

Horizon 2020 - ERA Net Latin America and Caribbean Countries/ UEFISCDI

Research Center

Ștefan Nădășan Laboratory

Research team

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