Erasmus+ Research Placements

in *Engineering*:

2021/2022

(October – December 2021)

List of research projects:

Project no.	*Title*
1	Designing and simulating a New Business Model for the Circular Economy applying System Dynamics (supervisor: **Dr Eduardo Munive**).
2	Development of a System Dynamics model to analyse the impact of COVID-19 on sustainable operations & supply chain management (Supervisor: **Dr Eduardo Munive**).
3	Optimum mix design of geo-polymer concrete (**Prof. Ashraf Ashour**)
4	Geopolymer concrete properties (**Prof. Ashraf Ashour**)
5	Artificial neural network modelling for different structural engineering applications (**Prof. Ashraf Ashour**)
6	Battery-free portable wireless biomedical sensors (**Dr Farshid Sefat**)
7	Visible Light Communication (VLC) based device to transfer Magnetic Resonance Imaging (MRI) images across an RF shielded room (**Dr Farshid Sefat**)
8	Magnetic Resonance (MR) safe electronic sensor for respiration detection during MRI scan (**Dr Farshid Sefat**)
9	Investigate the effect of Various X-Ray Radiation Dosages on Cellular Behaviour (**Dr Farshid Sefat**)
10	Finite element modelling of demountable shear connectors for composite structures (**Prof. Dennis Lam**)
11	SmartWall: Experimental Validation of RFID-enabled Human Activity Recognition using Multivariate Gaussian for Unobtrusive Health Monitoring (**Prof. Raed Abd-Alhameed**)
12	Design and Optimization of small Ultra wideband sensors for Body Centric Imaging Applications (**Prof. Raed Abd-Alhameed**)
13	5G Energy Efficient MIMO Small Cell Mobile Communications System (**Prof. Raed Abd-Alhameed**)
14	Development of Machine Learning System for Knowledge Extraction from Medical Data Sets (**Prof. Rami Qahwaji**)
15	Computer Vision Technology for real-time Face Recognition (**Prof. Rami Qahwaji**)
16	Development of Computer Vision System for Remote sensing and processing of satellite images (**Prof. Rami Qahwaji**)

17	Development of a biodegradable porous polymer film for agricultural applications (**Prof Adrian Kelly**)
18	Investigation of single polymer composites using bio-based materials (**Prof Adrian Kelly**)

Project number	1
Project Title	Designing and simulating a New Business Model for the Circular Economy applying System Dynamics (supervisor: Dr Eduardo Munive).
Project outline	This project involves analysing and modelling a new business model for an organisation offering a new product or service to understand how value is delivered to customers, reducing waste in logistic operations and improving its overall performance. A system-dynamics modelling approach will be applied. The business model should include a circular economy perspective.
Activities involved	• Literature review on business models, circular economy and system dynamics. • Learn to use the Anylogic software to develop and simulate system dynamics models.
Deliverables	• System dynamics models (using Anylogic) and set of recommendations for relevant stakeholders.
Prerequisites	• *Motivated to learn System Dynamics*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1 UG and 1 PG
Funding	Selected students will receive an Erasmus+ Grant

Project number	2
Project Title	Development of a System Dynamics model to analyse the impact of COVID-19 on sustainable operations and supply chain management (Supervisor: Dr Eduardo Munive).
Project outline	This project involves analysing and modelling the impact of COVID-19 on the successful management of sustainable operations and supply chain of an organisation. This analysis will provide recommendations to improve the level of resilience. A system-dynamics modelling approach will be applied.
Activities involved	• Literature review on the impact of COVID-19 on operations and supply chains, sustainability, and system dynamics. • Learn to use the Anylogic software to develop and simulate system dynamics models.
Deliverables	• System dynamics models (using Anylogic) and set of recommendations for relevant stakeholders.
Prerequisites	• *Motivated to learn System Dynamics*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1 UG and 1 PG
Funding	Selected students will receive an Erasmus+ Grant

Project number	3
Project Title	Optimum mix design of geo-polymer concrete (**Prof. Ashraf Ashour**)
Project outline	The main aim is to develop an optimum mix design method for geo-polymer concrete (GPC) to achieve prescribed properties in an easy, reliable way to the BRE method for cement-based concrete. The main focus will be on GPC cured at ambient temperature with target compressive strength and other acceptable mechanical/physical/chemical properties to promote their practical applications to structural elements. The project will create a comprehensive database of GPC available in the literature, use of design of experiments method to identify any gaps in the database and eventually use rational and/or AI techniques to develop GPC mix design method.
Activities involved	• Literature review/ computational modelling/writing a report
Deliverables	• Comprehensive database of GPC available in the literature • A rational and/or AI technique for the design of geopolymer concrete mix • Report describing the method used, results, discussion and conclusions.
Prerequisites	• *Material science, in particular in concrete mixes and properties; design of conventional concrete mix design; knowledge of AI, for example ANN or Fuzzy logic and optimisation techniques would be an advantage.* • *Knowledge on geopolymer concrete is advantage but not a must.*
Level:	Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	4
Project Title	Geopolymer concrete properties (**Prof. Ashraf Ashour**)
Project outline	The main aim is to experimentally test geo-polymer concrete (GPC) properties. Due to the environmental concerns of producing Portland cement, few eco-friendly binders have been developed and investigated in the literature, including alkali-activated materials referred to as “geopolymers” produced by reaction of certain aluminosilicate precursor with alkaline-activator. GGBS, FA, calcined clays and natural pozzolans are the most common aluminosilicate precursors, exhibiting good properties. This project will experimentally explore various properties of GPC, in particular the shrinkage and elastic modulus due to the limited results available in the literature on these properties.
Activities involved	• The project will cover lab testing and writing a report. Therefore, this project would not be possible/available during lockdown of the university and labs.
Deliverables	• Test results on geopolymer concrete properties, including shrinkage, modulus of elasticity. • Report describing the programme of testing, results, discussion and conclusions.
Prerequisites	• *Material science in civil engineering and standard testing of concrete; knowledge on geopolymer concrete is advantage but not a must.*
Level:	Postgraduate

Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	5
Project Title	Artificial neural network modelling for different structural engineering applications (**Prof. Ashraf Ashour**)
Project outline	The last two decades have witnessed an explosive growth in the application of artificial neural networks to different structural Engineering applications. An artificial neural network (ANN) is an assembly of a large number of highly connected nodes. The ANN has the ability to learn by examples of past data and to generalise this knowledge by making predictions for previously unseen input data. The project will use artificial neural networks to simulate and predict behaviour of different applications in civil engineering; MatLab provides a toolbox for neural network, which can be used for this purpose.
Activities involved	• Literature review/ computational modelling/writing a report
Deliverables	• A trained artificial neural network for designing various structural application • Report describing the method used, results, discussion and conclusions.
Prerequisites	• *Knowledge of structural engineering; ANN, use of Matlab or equivalent*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	6
Project Title	Battery-free portable wireless biomedical sensors (**Dr Farshid Sefat**)
Project outline	
Activities involved	• Develop design requirements • Define conceptual design • Design electronic sensors to read vital signs (heart rate, temperature., etc) • Design electrical antenna to harvest energy from soundings • Prototype and test sensors • Prototype and test antenna • Integrate antenna to sensors • Test performance of the final sensors
Deliverables	• A working prototype batter-free sensor • A test performance of the prototype sensor • A final documented design layout and BOM
Prerequisites	• *Basic Knowledge of operations of medical sensors* • *Basic knowledge of electronic and communications circuits*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end

Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	7
Project Title	Visible Light Communication (VLC) based device to transfer Magnetic Resonance Imaging (MRI) images across an RF shielded room (**Dr Farshid Sefat**)
Project outline	
Activities involved	• Develop design requirements • Define conceptual design • Design transmitter and receiver electronic circuits • Interface to Arduino • Prototype VLC transmitter and receiver • Test performance of the complete VLC device • Field test in an MRI machine
Deliverables	• A working prototype of the VLC device • A test performance of transmitting and image in MRI scan room • A final documented design layout and BOM
Prerequisites	• *Basic Knowledge of operations of medical sensors* • *Basic knowledge of electronic and communications circuits* • *Basic knowledge of VLC is desired but not necessary*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	8
Project Title	Magnetic Resonance (MR) safe electronic sensor for respiration detection during MRI scan (**Dr Farshid Sefat**)
Project outline	
Activities involved	• Develop design requirements • Define conceptual designs • Search for MR safe materials • Design of electronic sensor based on the MR safe materials • Prototype the electronic sensor and bench test • Test performance of the sensor in MRI machine • Scan the sensor in MRI machine to confirm that the sensor is MR safe
Deliverables	• A working prototype of the electronic sensor • A test performance of sensor in MRI scan room • A final documented design layout and BOM
Prerequisites	• *Basic Knowledge of operations of medical sensors* • *Basic knowledge of electronic and communications circuits*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2

Funding	Selected students will receive an Erasmus+ Grant

Project number	9
Project Title	Investigate the effect of Various X-Ray Radiation Dosages on Cellular Behaviour (**Dr Farshid Sefat**)
Project outline	
Activities involved	• Develop design requirements • Define conceptual design • Basic literature review in the field X-ray radiation dosages. • Prepare various cell types using cell culture system • Expose cells with selected X-ray dosages • Perform DNA damage assay
Deliverables	• Basic literature review in the field X-ray radiation dosages. • Prepare various cell types using cell culture system • Expose cells with selected X-ray dosages • Perform DNA damage assay
Prerequisites	• *Basic Knowledge of cell biology and radiation* • *Basic knowledge of Radiation physics* • *Basic knowledge of DNA damage analysis*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	10
Project Title	Finite element modelling of demountable shear connectors for composite structures (**Prof. Dennis Lam**)
Project outline	Developing a finite element model using FEM software ABAQUS to simulate the load slip characteristic of this form of shear connectors.
Activities involved	• Carry out literature review, developed your own FEM model using ABAQUS, and validated it against known experimental studies. • Carry out parametric studies with your FEM model. Develop formulae/ equations for use in codes of practice.
Deliverables	• Research report, journal publications.
Prerequisites	• *Experience in FEM software ABAQUS.*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	11
Project Title	SmartWall: Experimental Validation of RFID-enabled Human Health Activity Recognition within Indoor environment (**Prof. Raed Abd-Alhameed**)
Project outline	Human activity recognition from sensor readings has proved to be an effective approach in pervasive computing for smart healthcare. Recent approaches to ambient and assisted living (AAL) within a home or community setting offer people the prospect of more individually-focused care and improved quality of living. However, most of the available AAL systems are often limited by computational cost. In this project, a simple, novel unwearable human activity classification framework using machine learning will be proposed. The work will consider many possible patient orientations and locations within an indoor environment.
Activities involved	These includes: • Some programming skills. • Work on RFID system • Machine learning using Matlab. • Test and analysis the collected data.
Deliverables	This includes: • Develop the full software source code to work over many RFID tags. • Methods to mounted the tags. • Writing a report and draft a paper for a good Conference or Journal.
Prerequisites	• *The applicant should have basic programming skills either C or Matlab.*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	12
Project Title	Design and Optimization of small Ultra wideband sensors for Body Centric Imaging Applications (**Prof. Raed Abd-Alhameed**)
Project outline	Body centric wireless communications have enormous applications in military, space exploration, identification systems, breast cancer detection, personal health care systems, smartphones, and personal entertainment systems. These systems require antenna elements to communicate in Body centric sensing systems, usually formed by parts of wireless communications combining the network of Wireless Sensor Networks (WSNs), Wireless Body-Area Networks (WBANs), and Wireless Personal Area Networks (WPANs). the off, in-body, and on-body wireless communications. Due to having large bandwidth, low cost, high data rate, high resolution, and high resistance to interference, reasonable gain, and low power requirement, UWB antennas are more attractive than narrowband sensors for body-centric applications
Activities involved	This includes: • Some experience in using software related to sensor design for RF applications. • Programming skills using Matlab.

Deliverables	This includes: • Develop a new sensor working on the human tissues. • Work the images from the scanning using software. • Draft a report and possible paper publication.
Prerequisites	*This includes:* • *Programming skills using matlab or C.*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	13
Project Title	5G Energy Efficient MIMO Small Cell Mobile Communications System (**Prof. Raed Abd-Alhameed**)
Project outline	An energy-efficient smartphone with improved characteristics is proposed for 5G transceiver applications in this project. The applicant will work on FBGA and MIMO front end to establish the required 5G communications between two transceivers. The validation of the implemented hardware prototype based on 5G standards will be implemented and tested. Various soft-defined radio functions will be tested to see how the 5Gbe more Energy-efficient.
Activities involved	This includes: • Some activities of software programming. • Understand the spectrum for 5G. • Skills in communications systems.
Deliverables	This includes: • Develop a new source code to drive the FPGA and the MIMO system. • Approve to test the hardware based on the software developed. • Draft a report and possible paper publication.
Prerequisites	*This includes:* • *Programming skills using matlab or C.*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	14
Project Title	**Development of Machine Learning System for Knowledge Extraction from Medical Data Sets (Prof. Rami Qahwaji)**
Project outline	This project aims to apply a variety of machine learning algorithms (Neural Networks, Support Vector Machines, Fuzzy-Logic, etc) to process and extract useful medical and/or clinical insight from data sets that are generated by Healthcare experts. The principles of big data and deep learning could also be applied to aid the learning process. Real-life data sets will be used in this project.
Activities involved	• Data collection and representation • Data pre-processing and filtering • Data Processing (Feature Engineering) • Implementation of Machine Learning Algorithms • Performance Evaluation • Recommendations for real-life system deployment
Deliverables	• Prototype – Machine Learning system
Prerequisites	• *Basic knowledge in AI, data science and/or Machine learning*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	15
Project Title	**Computer Vision Technology for real-time Face Recognition (Prof. Rami Qahwaji)**
Project outline	Face recognition systems ate important for a variety of applications including controlling access to secured locations, identification of individuals, border crossings, etc. This project will investigate recent techniques in image processing and machine learning to develop prototype technology for the efficient processing of facial images to identify the people shown in these surveillance videos/images.
Activities involved	• Data collection and representation • Image/videos pre-processing and filtering • Extracting features from images/videos • Implementation of Machine Learning (Deep Learning) Algorithms • Performance Evaluation • Recommendations for real-life system deployment
Deliverables	• Prototype – Computer Vision System for Biometrics Identification
Prerequisites	• *Basic knowledge in Imaging, AI, and/or Machine learning*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	16
Project Title	Development of Computer Vision System for Remote Sensing and Processing of Satellite Images (Prof. Rami Qahwaji)
Project outline	Remote sensing applications require the processing of satellite or drones images to detect regions of interest, and develop a variety of applications such as prediction of natural hazards, tracking of certain events, processing and visualisation of big data sets, etc. Image processing and machine learning algorithms work together to process these images and provide useful higher-level knowledge, which can be used for the development of variety of prediction, tracking, recognition or visualisation applications.
Activities involved	• Introduction to satellites data processing and remote sensing • Image pre-processing and filtering • Extracting features from satellite images • Development of remote sensing system • Performance Evaluation • Recommendations for future developments
Deliverables	• Recommendations for Remote Sensing System
Prerequisites	• *Basic knowledge in Imaging, AI, and/or Machine learning*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	17
Project Title	Development of a biodegradable porous polymer film for agricultural applications (Prof Adrian Kelly)
Project outline	The aim of the project will be to investigate how a combination of highly porous structures containing active ingredients such as fertilizers can be incorporated into polymer films.
Activities involved	• Experimental work in polymer processing; melt mixing formulations, developing methods to produce and orientate porous films • Characterisation of the produced materials, including scanning electron microscopy, mechanical properties and release rate of the active ingredients
Deliverables	• Research report (possibly conference or journal publication)
Prerequisites	• *Engineering or materials background*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1 (linked to a second place in Chemistry working on the same project – with Dr Sanjit Nayak)
Funding	Selected students will receive an Erasmus+ Grant

Project number	18

Project Title	Investigation of single polymer composites using bio-based materials (**Prof Adrian Kelly**)
Project outline	Single polymer composite are made by orienting fibres of tapes of a polymer and then fusing layers of this material together such that the boundaries melt but the highly orientated core remains intact. This has been used to great effect with materials such as 'Curv' – best known for use in Samsonite suitcases. Here we will investigate how bio-based polymer such as PLA could be used to make similar high strength composite materials.
Activities involved	• Polymer processing – melt mixing various polymer and additives • Orienting polymer tapes (stretching them to increase strength and orientation) • Hot pressing layers of orientated tapes to form single polymer composites • Characterisation of the composites, including mechanical strength and morphology using scanning electron microscopy and thermal analysis
Deliverables	• A research report (plus possible conference of journal paper, dependent upon the outcomes)
Prerequisites	• *Engineering or materials background; interest in polymers*
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant