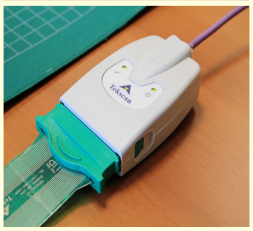
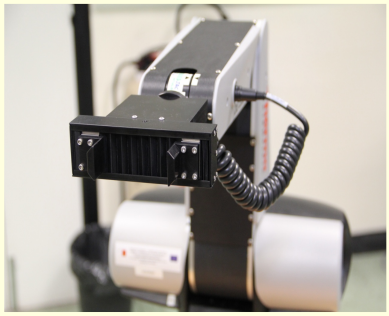
University of Malta
L-Università ta' Malta

Annual Activity Report

2010 - 2011





Department of Systems and Control Engineering

Annual activity report for the year 2010 - 2011, published by the

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Faculty of Engineering
University of Malta
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October 2011

Cover picture shows the various equipment found in the Control Systems Laboratory and the Biomedical Engineering Laboratory.

Contents

1. Introduction 2

2. Staff Members 4

3. Research activities 5

3.1 Low Cost 3D Head Acquisition 5
3.2 Intelligent Control of Solar Water Heaters 6
3.3 Early Stage Design for Rapid Prototyping 7
3.4 Brain Computer Interfacing 8
3.5 Spatio-temporal Modelling for Systems Biology 10
3.6 Spatio-temporal Analysis of Pollution Data 11
3.7 Computer Vision for Planetary Exploration 12
3.8 Cognitive Vision for Sketch Understanding 13
3.9 Vision for Real-time Autonomous Mobile Robot Guidance 13

4. Infrastructural projects: 15

4.1 The Control Systems Engineering Laboratory 15
4.2 The Biomedical Engineering Laboratory 16

5. Student Projects and Supervision 19

5.1 B.Eng. students 19
5.2 M.Sc. students 20
5.3 M.Phil / Ph.D candidates 20

6. External lecturers and visitors 21

7. Teaching activities 22

8. Staff publications (Oct 2010 ~ Sept 2011) 23

9. Staff activities 24

10. Prizes, awards and appointments 27

11. Participation in courses and meetings 27

12. Collaboration with third parties 28

1. Introduction

Another year over sees the publication of this third Annual Activity Report from the Department of Systems and Control Engineering covering the period 2010/11. As in previous years, the past 12 months have been very eventful for the Department.

The two major infrastructural projects, partially funded by the European Union's Regional Development Fund, involving the setting up of a new Biomedical Engineering Laboratory and the modernization of the Control Systems Engineering Laboratory were officially concluded during the past year. These two laboratories are now equipped with state-of-the-art technology, worth over €1 million, for the benefit of students, researchers and staff members who utilize this equipment for both research and didactic purposes.

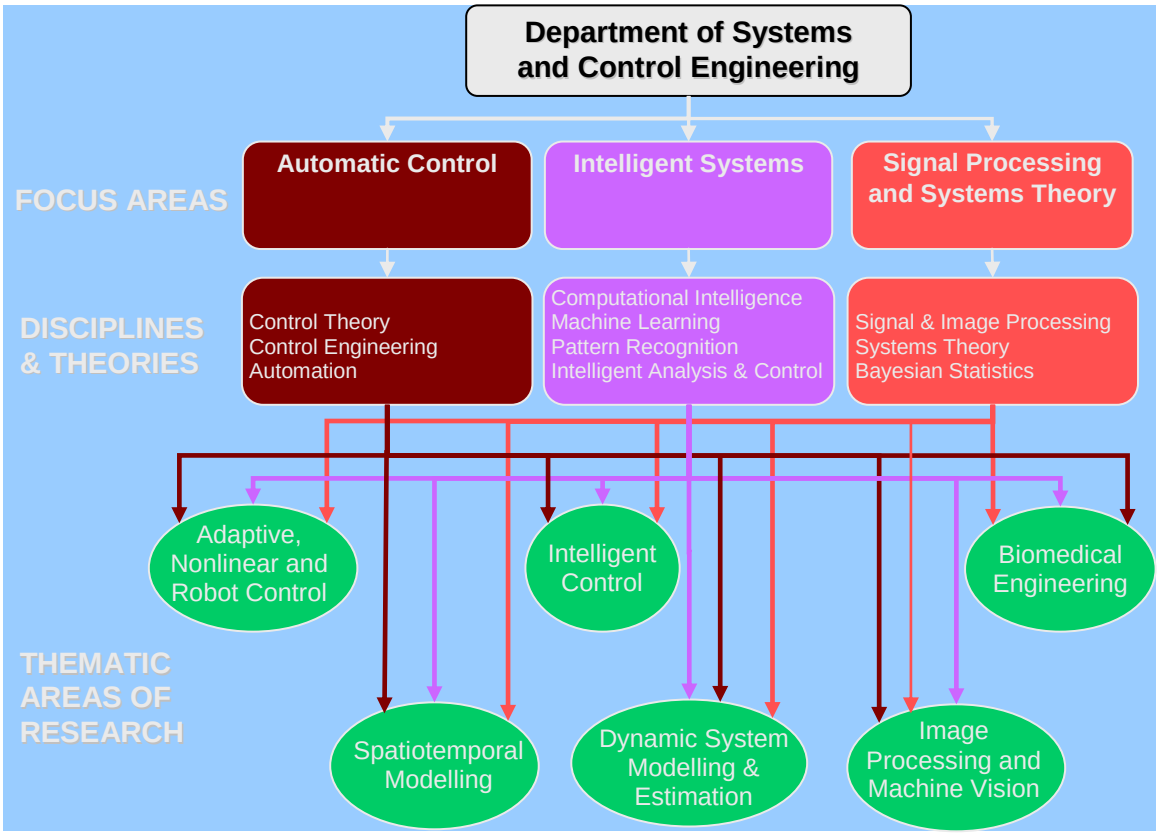
The research activities of the Department are reflected by several ongoing projects which are described in detail in this report. The high standards and quality of our research has led to the publication of a significant number of peer-reviewed journal articles, book chapters and conference papers, some of which include the collaboration and co-authorship of colleagues from renowned international universities.

On the teaching front, the Department offered several study-units at both undergraduate and post-graduate levels and supervised 12 undergraduate, 5 M.Sc and 7 M.Phil/Ph.D students pursuing engineering projects or advanced research programmes.

In a short introduction it is impossible, nor indeed opportune, to mention all the deliverables and achievements of the Department in the past year. I therefore urge you to read the contents of this document so as to get a complete picture of our major works and activities during 2010/2011.

I would finally like to thank all the staff members of the department, both non-academic and academic, for their continuous support and dedication. I thank you all for supporting me in my role as Head of Department and for your efforts to make this Department what it is: a truly dynamic and active entity dedicated to teaching, research, promotion and advancement of knowledge in the exciting areas of Systems and Control Engineering.

Prof. Simon G. Fabri
Head of Department
October 2011


Department of Systems and Control Engineering
FOCUS AREAS
Automatic Control
Intelligent Systems
Signal Processing and Systems Theory
DISCIPLINES & THEORIES
Control Theory
Control Engineering
Automation
Computational Intelligence
Machine Learning
Pattern Recognition
Intelligent Analysis & Control
Signal & Image Processing
Systems Theory
Bayesian Statistics
THEMATIC AREAS OF RESEARCH
Adaptive, Nonlinear and Robot Control
Intelligent Control
Biomedical Engineering
Spatiotemporal Modelling
Dynamic System Modelling & Estimation
Image Processing and Machine Vision

2. Staff Members

Associate Professors:

Prof. Ing. Kenneth P. Camilleri, *B.Elec.Eng.(Hons.), M.Sc. (Sur.), Ph.D. (Sur.), MIEE, SMIEEE, ACIArb*

Prof. Ing. Simon G. Fabri, *B.Elec. Eng. (Hons.), M.Sc. (Sheff.), Ph.D (Sheff.), SMIEEE* – Head of Dept.

Lecturers:

Dr. Kenneth Scerri, *B.Eng. (Hons.), M.S. (Oakland), Ph.D (Sheff.), MIEEE*

Assistant Lecturers:

Ms. Alexandra Bonnici, *B.Eng. (Hons.), M.Phil, MIEEE*

Ing. Marvin K. Bugeja, *B.Eng. (Hons.), MIEEE*

Ms. Tracey Cassar, *B.Eng. (Hons.), MIEEE*

Visiting Teaching Staff:

Mr. Carl Azzopardi, *B.Eng. (Hons.), MIEEE*
Ing. Andre Sant, *B.Eng.(Hons). M.Sc., MIEEE*

Research Assistant:

Mr. Owen Falzon, *B.Eng. (Hons.), MIEEE*

Systems Engineer:

Ms. Stefania Cristina *B.Eng. (Hons.), M.Sc.*

Laboratory Officer II:

Mr. Noel Agius

Executive Officer:

Ms. Allison Sultana, *Dip. Mgt., MBA (Exec)*

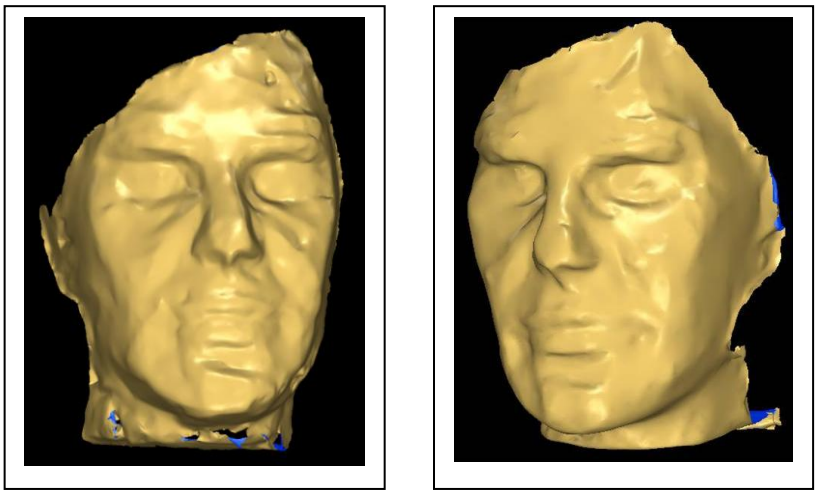
3. Research activities

The Department gives great importance to its research activities. Several projects have been ongoing during the last academic year, aided by funding from internal and external sources. Most of the projects, which are led by academic staff members, include the participation of postgraduate students whose research contributions lead to the award of Doctoral or Master degrees. The main projects which have been in preparation, ongoing or concluded during academic year 2010/11 are described in the following pages.

3.1 Low Cost 3D Head Acquisition

Main investigators: Prof. Kenneth P. Camilleri and Ms .Stefania Cristina.

This industry-academia collaborative project funded by a grant from the National RTDI Programme 2004 was concluded this year. This project was concerned with the development and implementation of a low-cost 3D object rapid-acquisition system, specifically for the acquisition of the 3D data of a person's head. A combination of simple projected patterns and multiple view passive correspondence together with novel algorithms to exploit the multi-view redundancy were developed and integrated into a working system. Specific algorithms developed within this project and their performance were presented at and published in the proceedings of the 8th International Conference on Informatics in Control, Automation and Robotics (ICINCO 2011) which was held in the Netherlands in July 2011.

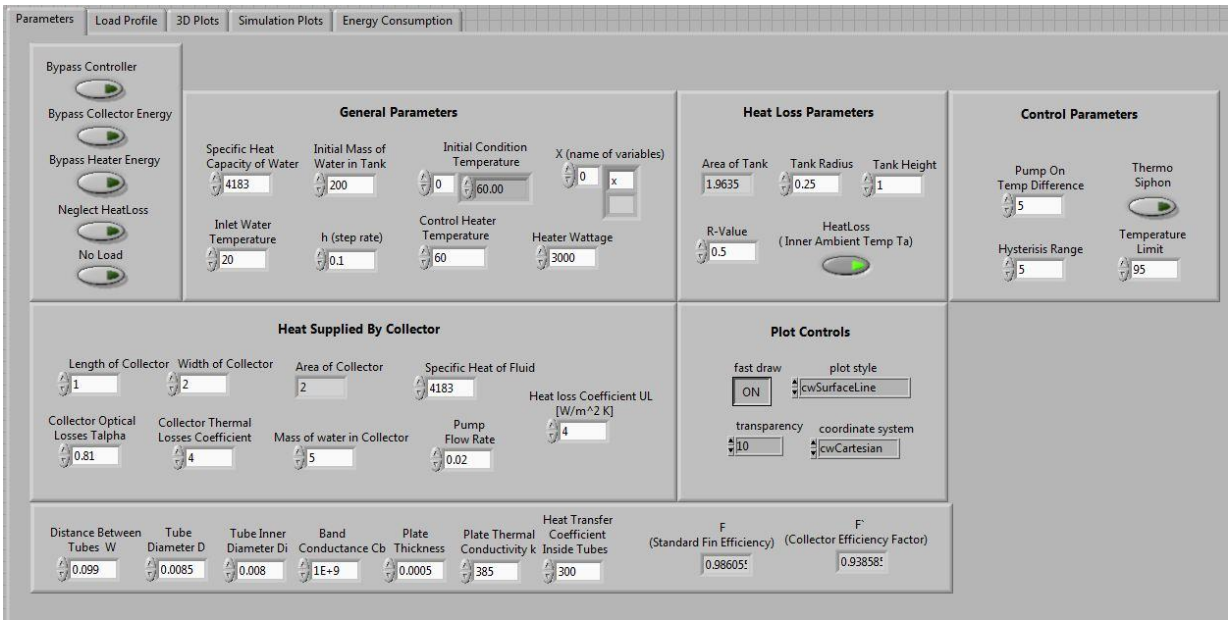


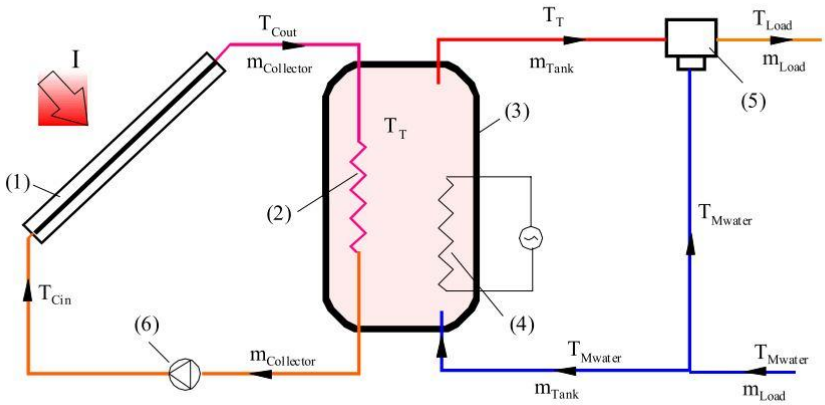
Surface maps of a mannequin head obtained using the 3D acquisition system.

3.2 Intelligent Control of Solar Water Heaters

Main investigators: Prof. Simon G. Fabri, Mr. Reuben Debono and industrial collaborators.

This project, funded by the National R&I Programme 2008, is approaching its final stages. The Department collaborated with two industrial partners, ESDL Ltd. and Bajada International Solar Systems Ltd., to develop an innovative and intelligent controller aimed to reduce the electrical energy consumption of solar water heaters when the temperature of the water needs to be boosted by the electric heater due to insufficient solar exposure. The proposed controller takes into account various parameters which may affect the performance and utilization of the system, resulting in more efficient and effective control than the conventional method used to regulate the solar unit's backup heater. The project also included the development and implementation of an extensive simulation model which captures the dynamics of a typical solar water heating system.



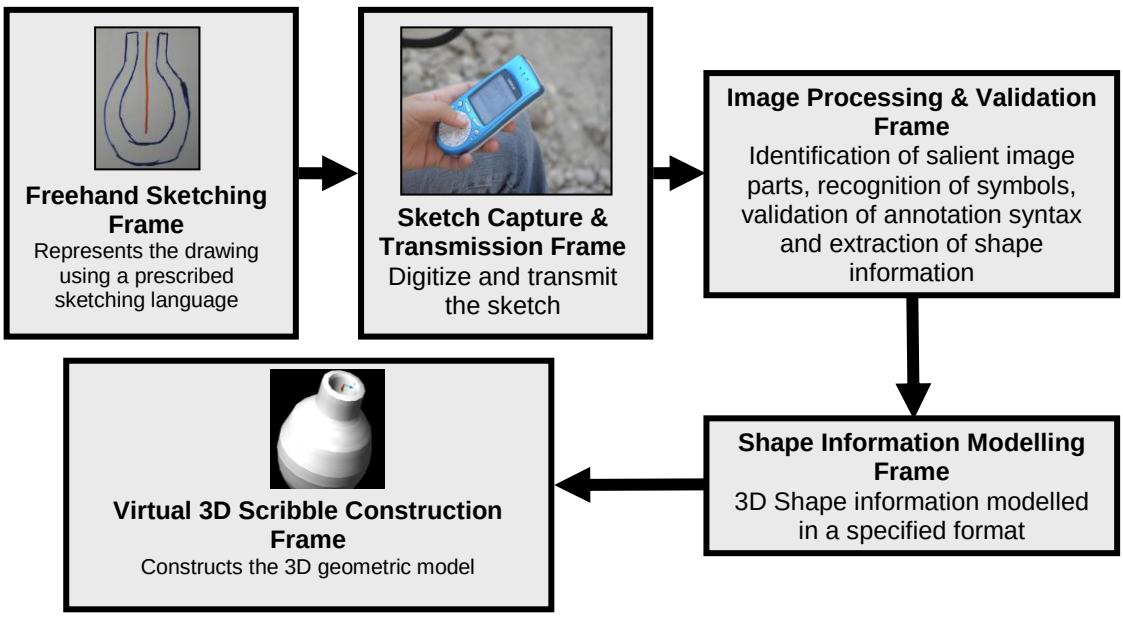


3.3 Early Stage Design for Rapid Prototyping

Main investigators: Prof. Kenneth P. Camilleri, Ms. Alexandra Bonnici, Prof. Jonathan Borg (Dept of Industrial Manufacturing Engineering), Dr. Philip Farrugia (Dept of Industrial Manufacturing Engineering)

This project is funded by a research grant from the University of Malta. It is a joint collaboration between the Department of Systems and Control Engineering and the Department of Industrial Manufacturing Engineering. The project concerns the development, implementation and evaluation of a computer-based tool that supports the automatic and remote generation of 3D models from 2D freehand paper-based sketches and scribbles. The aim of this research is to give designers the possibility to create virtual prototypes directly from paper-based scribbles using minimal effort. The work falls into two main areas, namely the area of Rapid Prototyping Technologies and Design and that of Image Processing, Perceptual Understanding and Machine Intelligence. Since the driving factor of the project is to allow designers to create 3D models from paper-based scribbles, the research activity focuses on methods with which the designer may represent drawings as well as the interpretation of these drawings, such that 3D models that represent the designer's intent may be obtained rapidly. This project has yielded several publications in peer-reviewed proceedings of international conferences and journals, as well as a patent.

This work has recently been extended, in collaboration with the Department of Metallurgy and Materials Engineering, to manufacture 3D virtual models using the sketch-to-3D prototype tool by means of laser cladding process. During this last year, the project's effort was directed towards the training of mechanical engineering students in early form design, facilitating a remote collaborative design process.



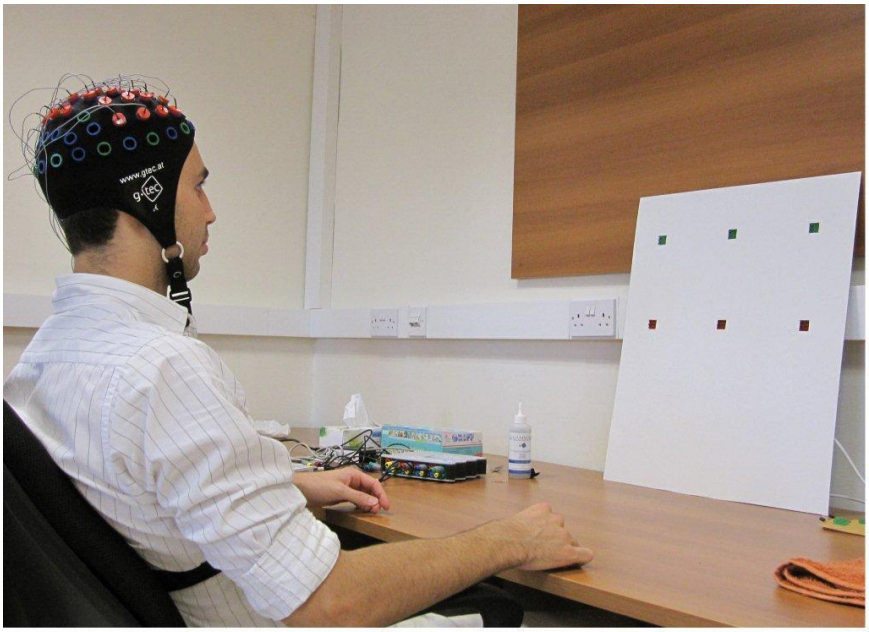
3.4 Brain Computer Interfacing

Main investigators: Prof. Kenneth P. Camilleri, Mr. Owen Falzon, Ms. Tracey Cassar, Prof. Simon G. Fabri

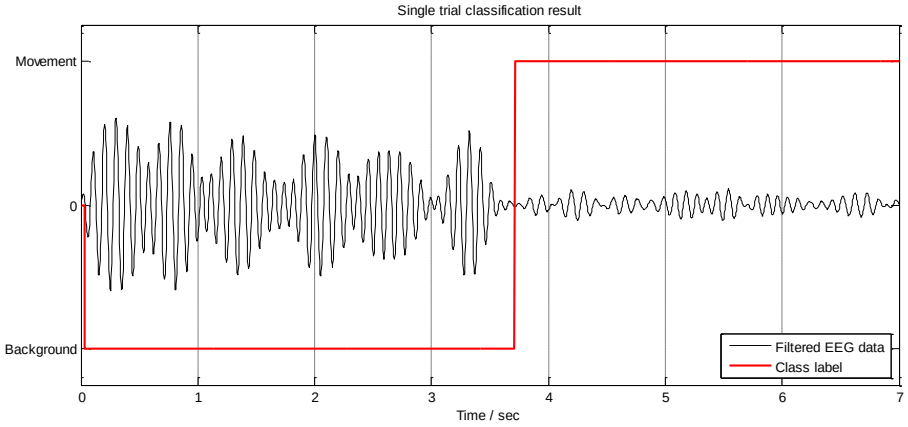
This project is funded by a research grant from the University of Malta and the Malta Government Scholarship Scheme which is providing support for one research student. A Brain Computer Interface (BCI) system is a communication system where a person has the ability to communicate with a computer through his or her brain signals rather than using the peripheral nerves and muscles. Generally electroencephalographic (EEG) data is recorded non-invasively from the human subject and this is then processed to extract reliable features to classify the tasks being performed, such as left/right hand movements, foot movements or tongue movements. These tasks are then mapped into computer based commands to move a cursor on a screen or select from sets of letters, amongst other examples.

One area of investigation that is presently being pursued concerns the application of switching multiple modelling techniques to segment EEG data into different mental tasks, applying expert models to each task and using this knowledge for asynchronous brain computer interface applications. Rather than extracting features from the EEG to characterize the mental tasks and then feeding these to a classifier to determine the class the current data belongs to, the multiple modelling technique uses pre-trained expert models to predict the EEG data and uses the residual within a Bayes classifier to find the most probable model out of the candidate set. This has the advantage that once training of the models is performed, segmentation and labelling of new data is done in a more computationally efficient manner.

Another area of investigation concerns the phase analysis of the EEG multi-channel data. The well-known technique of Common Spatial Patterns (CSP) has been re-formulated into two different algorithms that allow analysis of phase-lock and phase difference between the signals from EEG channels. The novel ‘Phase-lock CSP’ method has been shown to perform more efficiently than techniques that rely directly on the well-known Phase-Locking Value (PLV) for phase lock analysis in EEG signals in the classification of mental states. The other novel ‘Analytic CSP’ technique has been shown to have the capability of directly estimating the amplitudes and phase differences of multi-channel narrow-band signals that characterise different mental states.



SSVEP BCI application

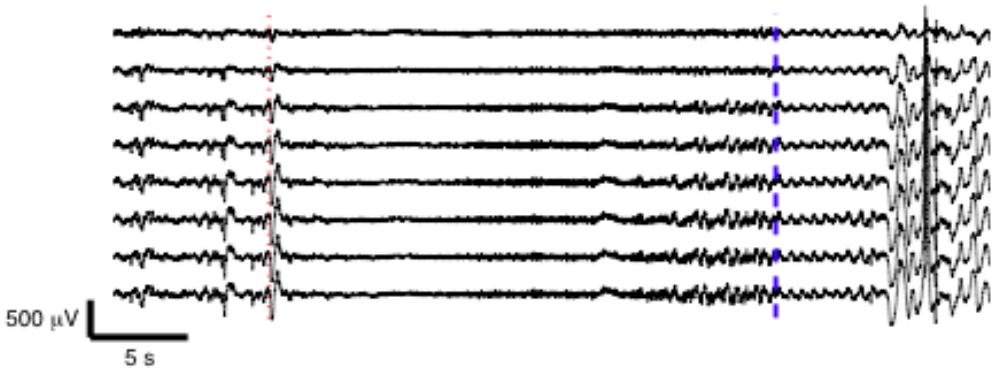


Segmentation and labelling of a single trial of EEG data into background and movement modes.

3.5 Spatio-temporal Modelling for Systems Biology

Main investigators: Dr. Kenneth Scerri in collaboration with Prof. Visakan Kadirkamanathan at the Department of Automatic Control and Systems Engineering, University of Sheffield (Sheffield, UK), Dr. Michael Dewar at Department of Applied Physics and Applied Mathematics, Columbia University (New York, USA) and Dr. Dean R. Freestone, Department of Electrical and Electronic Engineering, University of Melbourne, (Melbourne, VIC, Australia).

This research, which originated at the Department of Automatic Control and Systems Engineering at the University of Sheffield, has seen the input of staff members from the Department of Systems and Control Engineering. As part of Dr. Scerri's doctoral studies, novel methods based on systems theory for the estimation of spatio-temporal interactions have been developed. In this research these methods are being extended and applied to the modelling and analysis of EEG signals with the aim of obtaining mathematical descriptions of the electrical activity inside the brain. This work has been published in prominent international journals such as 'Neuroimaging'.



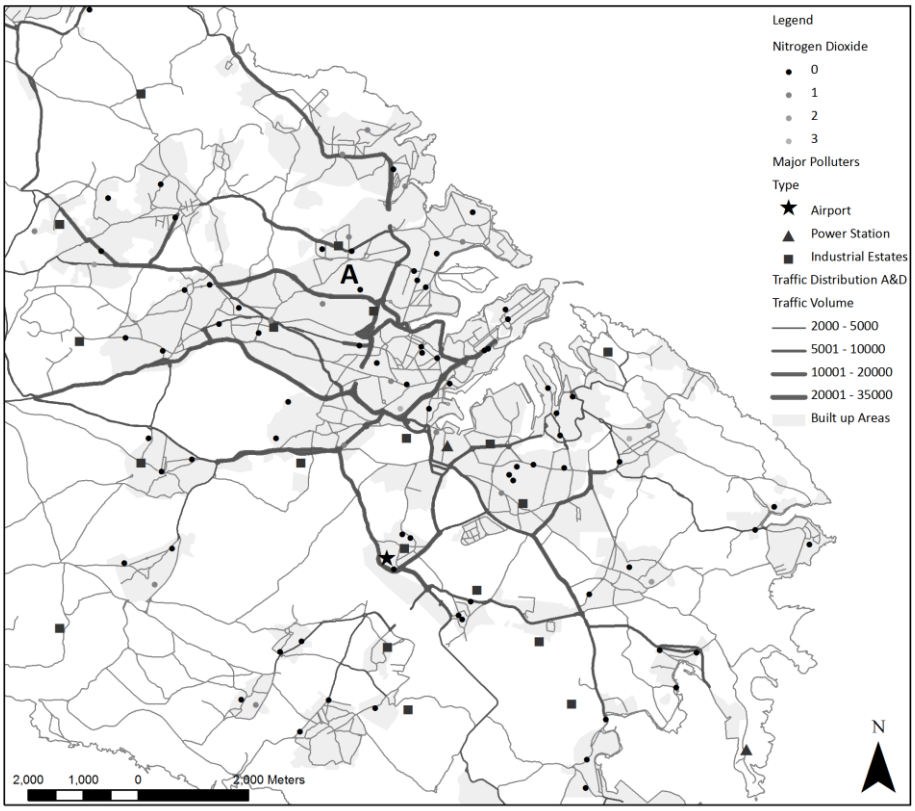
Measured neural activity before and during an epileptic fit

Sensor patch used to measure neural activity

3.6 Spatio-temporal Analysis of Pollution Data

Main investigators: Dr. Kenneth Scerri and Ms. Luana Chetcuti Zammit in collaboration with Dr. Maria Attard and Ms. Therese Bajada at the Institute of Sustainable Development at the University of Malta and Mr. Mark Scerri at the Environment Protection Directorate of the Malta Environment & Planning Authority.

The Environment Protection Directorate of the Malta Environment & Planning Authority has been collecting pollution measurements using diffusion tube technology since 2004. Unfortunately, this data has not been extensively analyzed, mostly due to the technical challenges involved in dealing with such noise corrupted measurements. The aim of this project is to apply a systems theory approach that effectively deals with the noise introduced in the measurements for the analysis and modeling of this data. This work has shown that pollution patterns in Malta are highly uncorrelated, indicating that local sources rather than diffusion are the prominent dynamics behind these pollution measurements. Future work aims to obtain transport models describing the travel patterns in Malta and quantitatively relating these models to the pollution patterns being observed. The pollution modeling results have been recently published at an international conference and this work was chosen by the conference chairs for publication in a special journal issue covering the conference.



Correlation analysis results

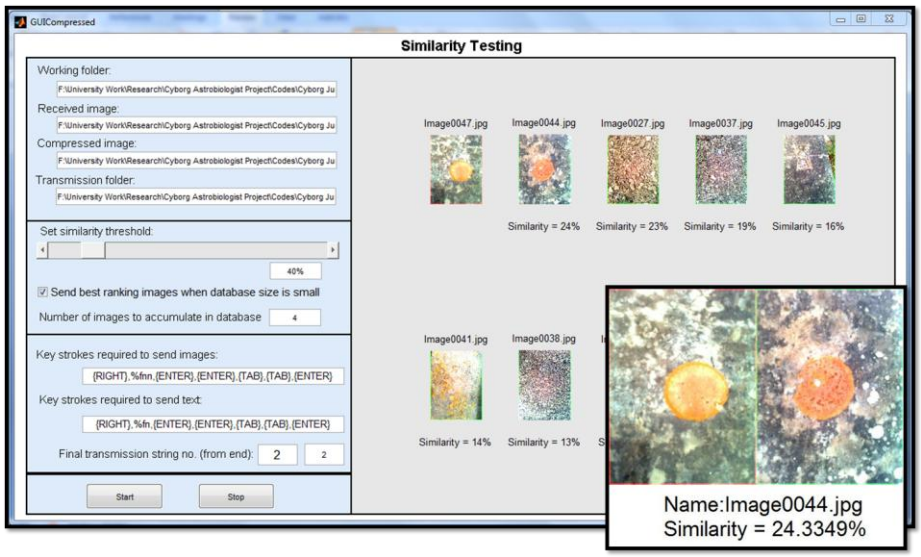
3.7 Computer Vision for Planetary Exploration

Main investigators: Ms. Alexandra Bonnici in collaboration with Dr. Patrick McGuire at the Department of geophysical Sciences, University of Chicago.

The Cyborg Astrobiologist project, in collaboration with Patrick McGuire[1] (currently at the University of Chicago) has demonstrated that the experience of astrobiologists working on the development and testing of computer-vision algorithms for planetary exploration may be enhanced by porting the bulky camera and wearable computer to a much smaller mobile phone. Using such a system, a blue-tooth connection is used to transmit and receive images to a main computer which performs the necessary computer-vision algorithms to assist the astrobiologist in his/her investigations.

In recent work on this project, images taken by the astrobiologist during an exploration session are compared to each other such that each new image is compared to all other images during the exploration session. The textures in pairs of images are compared, enabling the algorithm to rank the previously enountered images according to similarity. Thus, the astrobiologist is given a quantitative measure of the similarites present in the explored region.

[1] http://epsci.wustl.edu/~mcguire/



Screen shot of the software used to perform comparison testing. Insert at bottom right illustrates the mostly matched pairs of images from the images captured. Both images show orange lichens on a stone path.

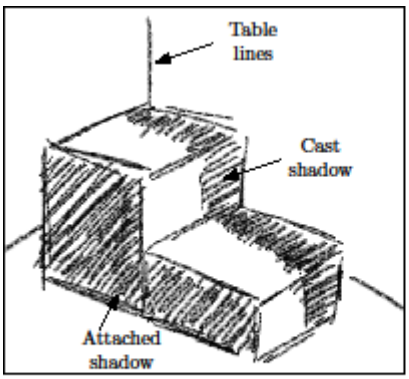
3.8 Cognitive Vision for Sketch Understanding

Main investigators: Prof. Kenneth P. Camilleri, Ms. Alexandra Bonnici

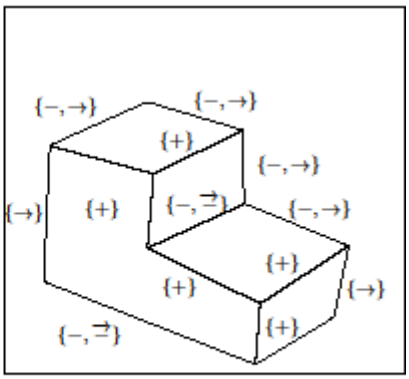
The objective of this project is to develop image processing algorithms through which sketches can be interpreted in the same manner as human observers, allowing designer sketches to be represented as 3D scenes.

In this project, we investigate the interaction of sketch cues such as shadows and table lines on the interpretation of edges in the drawing. We investigate the use of genetic algorithms to combine these cues with the known allowable geometric interpretations of junctions to evolve a plausible interpretation of the sketch.

The project also investigates the algorithmic identification of these sketched cues in order to obtain an automated interpretation of the sketch.



Sketched Drawing



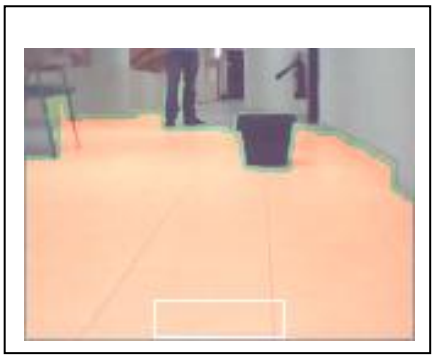
Labeled Representation. Each edge can be labeled with a label from the following set of labels: $\{+, -, \rightarrow, \overrightarrow{-}\}$

3.9 Vision for Real-time Autonomous Mobile Robot Guidance

Main investigators: Prof. Kenneth P. Camilleri, Mr Michael Sapienza

In this project a monocular real-time vision system for a mobile robot was developed to guide the robot in an unknown indoor or outdoor environment and allow the robot to explore the environment autonomously. An essential capability for the mobile robot is to be able to discriminate between traversable surfaces and obstacles in the environment. It may be noted that while the traversable surface may have a consistent appearance model, the obstacle regions vary greatly and thus effectively training the robot for obstacle regions may be difficult. For this reason, a semi-supervised approach was adopted in this work and through the use of the Expectation-Maximization algorithm and a novel generative model for traversability cues, a principled probabilistic traversability detection method was developed and evaluated, off-line and on-line in real-time. The performance of the proposed method demonstrates that it may be applied in a variety of indoor and outdoor

environments. The proposed method performs well and is comparable to similar approaches, in view that our solution does not explicitly exploit any temporal information and also makes it possible for the self-guided robot to achieve closer proximity to the obstacles without collisions.



4. Infrastructural projects:

The Department of Systems and Control Engineering, benefiting from grants of over €1 Million from the European Regional Development Fund (ERDF) under the Cohesion Policy Programme 2007-2013, has this year successfully concluded two major infrastructural projects:

- the modernization and upgrade of the Control Systems Engineering Laboratory,
- the setting up of a new Biomedical Engineering Laboratory.

These two projects will support the transfer of knowledge to students, and indirectly to industry and society, as well as the research and development activities of the members of the Faculty of Engineering and its research students. The laboratories will serve to attract students to specialize in the areas of Automatic Control Engineering and Biomedical Engineering, stimulate collaboration with overseas universities and research institutions, and enable joint research and development projects with industry and relevant stakeholders. Further details on these laboratories are given below.

4.1 The Control Systems Engineering Laboratory

The Control Systems Engineering Laboratory services the University's practical teaching and research activities in the area of Automatic Control Engineering. By means of the ERDF project entitled 'Modernizing the University of Malta's Control Systems Engineering Laboratory', the equipment infrastructure of the laboratory has been completely modernized and revamped through a grant of around €600,000. This upgrade involves the acquisition and installation of state-of-the-art equipment to be used for both research and didactic purposes. The equipment focuses on modern automation technology including process control, mechatronics, robot control, programmable logic control, CAD tools for control system design, embedded control systems, vision-based automation and automatic access control.

The facilities in the laboratory now include a set of industrial-standard Programmable Logic Control (PLC) units from Allen Bradley, together with the associated Human Machine Interface (HMI) terminals and programming software. The PLC units include digital and analogue input/output ports as well as Ethernet, ProfiBus and ASi modules for fieldbus communications.

The laboratory also houses a rich and varied set of robotic equipment including several modular robot assembly kits from LEGO Mindstorms with NXT and RobotC programming software, a team of Khepera III small-scale mobile robots ,two high-end PowerBot mobile robot platforms from Adept MobileRobots, and two Catalyst-5

robotic arms with servo grippers and controllers. The equipment also includes a suite of advanced sensors for robotic applications including 6-axis force/torque sensors, laser rangefinders and inertial navigation sensors.

In order to support the design and integration of complex systems, the laboratory is furnished with a number of embedded PCs, tablet PCs and several interface boards from dSPACE and Quanser for real time measurement and computer control. The facilities also include a set of PC interfaced dc servomechansims and liquid level process control units mainly to be used for didactic purposes.

The new equipment also covers the area of automated access control through the provision of fingerprint, palmprint and iris biometric scanning equipment. This is complemented by vision-based automation equipment which can be applied on robotic, automatic inspection and monitoring applications. These include analogue and digital area scan cameras, smart cameras with LED illumination, stereo cameras with pan/tilt actuation, and various digital and analogue video grabbers and camera multiplexers.

All this equipment is supported by a backbone of standard electronic test and measurement instruments (oscilloscopes, powers supplies, signal generators), robust laboratory work benches, networked PC workstations, and Matlab/Simulink software licences for computer-aided analysis, design, simulation and real-time control of dynamic systems.

The newly modernized Control Systems Engineering Laboratory

4.2 The Biomedical Engineering Laboratory

The new Biomedical Engineering Laboratory was set-up with the support of ERDF project entitled 'Strengthening of Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities' which provided a grant of over €500,000 to acquire new state-of-the-art equipment. The laboratory is equipped with a variety of biomedical data acquisition devices that, in most cases, allow access to the data in

real-time and in an on-line manner thus allowing researchers to acquire the data into their own systems and process the data in an on-line manner with user-developed processing algorithms opening up the possibility for real-time feedback and algorithm integration into the existing devices. The technical accessibility of the devices in this Laboratory makes it possible to investigate new methods for clinical data acquisition and analysis and for the development of new medical devices. Six of the major biomedical data acquisition devices are described here below.

A Vicon Motion Analysis System that has the capability of tracking a person, animal or object in a three-dimensional volume has been installed in the Laboratory. The system incorporates a three-axis force plate, essential to obtain the kinetics of a moving entity, as is required, for example, in clinical gait analysis. A wireless electromyogram (EMG) system is also integrated into the system thus allowing multi-modal human motion analysis.

Body pressure measurement studies may be carried out using the Tekscan Body Pressure Measurement System. The system is equipped to measure seat and back pressure, foot and in-shoe pressure and hand-grip pressure. Application peripheral interface software allows on-line access to the body pressure measurement data acquired.

The Ultrasonix Diagnostic Ultrasound installed in the Laboratory goes beyond the diagnostic function by providing a research function opening up access to developments in new ultrasound scanning protocols, new diagnostic and measuring software tools and new ultrasound signal and image analysis.

The Flir Thermal Camera with a sensitivity of 0.02 degrees Kelvin allows thermal imaging with very high radiometric temperature sensitivity. Subsurface phenomena that result in a small change in surface temperature may be detected and imaged by this thermal imager. The application of thermal imaging to biomedical and clinical situations is growing rapidly. Temperature levels and gradients in living systems may now be explored with this equipment and will allow novel clinical applications to be developed.

Bio-potential measurements and studies may be carried out using the G-tec bio-potential acquisition device is used to acquire bio-potentials such as the electrocardiogram (ECG) or the electroencephalogram (EEG). The Department of Systems and Control Engineering has a long standing research history concerning EEG for the development of new brain disease biomarkers, for the localisation of brain activity and for the development of brain-computer interfaces. This equipment is now making it possible for our researchers to design our own experimental protocols and acquire our own EEG data, opening new avenues for exploration.

A variety of biomedical data may be acquired using the Biopac Biomedical Data Acquistion system. This system integrates the acquisition of various multi-modal biomedical data from body thermometers, tri-axial accelerometers, goniometers and torsiometers, skin conductance measurement device, pulse oximeter, bio-impedance

measurement system, hand dynamometer and non-invasive blood measurement device. The Biomedical Engineering Laboratory also houses a hyperspectral camera, a robotic manipulator, a haptic feedback system, processing and interfacing boards, and software and hardware computing facilities.

Operational Programme I – Cohesion Policy 2007-2013
Investing in Competitiveness for a Better Quality of Life
Equipment part-financed by the European Union
European Regional Development Fund
Co-financing rate: 85% EU Funds; 15% National Funds

Investing in your future

5. Student Projects and Supervision

5.1 B.Eng. students

Project title	Student	Supervisor
Image Classification in Capsule Endoscopy	Bonello Maria	Mr. C. Azzopardi, Prof. K. Camilleri
The Pendubot: Design, Implementation and Control	Camilleri Josef	Ing. M. Bugeja
Eye blink Detection for Blink Pattern Analysis	Cassar John Paul	Ms. S. Cristina, Prof. K. Camilleri
Control of a Double Inverted Pendulum on a Cart	Cassar Joseph	Ing. M. Bugeja
Multiclass motor imagery BCI system	Damato Elaine	Prof. S. Fabri
Closed Loop of a Laser Cladding System using a Video Camera	Farrugia Magro Michael	Dr. K. Scerri
Spatio-Temporal Modelling, Analysis and Control of Air Pollutants in Malta	Grech Gaynor	Dr. K. Scerri
Particle Swarm Optimization for Control Design	Mercieca Julian	Prof. S. Fabri
Classification of Neurotransmitter Voltammograms through Neural Networks	Sammut Mario	Mr. C. Azzopardi, Prof. K. Camilleri
Non-linear Control of a Ball & Plate System	Vella Andrew	Ing. M. Bugeja
Stochastic Techniques for Modelling of Dynamic Systems	Vella Francesca	Prof. S. Fabri
Idle State Detection in Motor Imagery Based BCI	Zammit Christian	Ms. T. Cassar

5.2 M.Sc. students

Project Title	Student	Supervisor
3D model based object recognition using assembly of discrete primitives	Agius David Paul	Prof. K. Camilleri
Date Driven Spatio-Temporal Modeling	Chetcuti Luana	Dr. K. Scerri, Prof. S. Fabri
Intelligent control of solar water heaters	Debono Reuben	Prof. S. Fabri
Integrated waste management as a climate change stabilization wedge for the Maltese islands	Falzon Clyde	Prof. S. Fabri
Vision for autonomous mobile robot guidance	Sapienza Michael	Prof. K. Camilleri

5.3 M.Phil / Ph.D candidates

Research Title	Candidate	Supervisor
Combining the X-basis of vision to provide a valid 'human vision' interpretation of scribbled drawings	Bonnici Alexandra	Prof. K. Camilleri
Computational intelligence methods for dynamic control of mobile robots	Bugeja Marvin	Prof. S. Fabri
Multiple modelling of EEG data to classify different mental tasks	Cassar Tracey	Prof. K. Camilleri, Prof. S. Fabri
Eye-Gaze Tracking for Human-Computer Interaction, Behaviour Analysis and Communication	Cristina Stefania	Prof. K. Camilleri
Representation and Knowledge Extraction from Multiview Image and Video	DeRaffaele Clifford	Prof. K. Camilleri
The application of signal modeling and computational intelligence techniques for the analysis of EEG data	Falzon Owen	Prof. K. Camilleri
Modelling Spatial Context in Maltese Sign Language Recognition from Video Sequences	Borg Mark	Prof. K. Camilleri, Dr. M. Alexander

6. External lecturers and visitors

From the University of Le Havre, France…

In November 2010, the Department hosted three staff members from the University of Le Havre in France: Dr. Francois Guerin, Dr. Florence Lecroq and Mr. Frederic Chaigne. Dr. Guerin and Dr. Lecroq delivered lectures to 3rd and 4th year B.Eng. Electrical Engineering students taking the Control Engineering elective study-units. Dr. Guerin presented a mini course on the programming of FPGAs and their application to control engineering, and Dr. Lecroq delivered a lecture on Programmable Logic Control (PLC) systems and automation. Mr. Chaigne provided technical support for the installation of new PLC equipment in the Control Systems Engineering laboratory. This visit was funded by the EU Socrates-Erasmus programme.

The delegation from the University of Le Havre in the Control Laboratory. From left to right: Mr. Chaigne, Prof. S. Fabri, Dr. Lecroq, Dr. Guerin.

From the California Polytechnic State University, U.S.A…

On the 10th and 17th March 2011, the Department hosted Dr. Christopher Clark from the California Polytechnic State University who presented two talks entitled *Underwater Robotics: Applications Driven by Science;* and *Coordinating Multiple Autonomous Vehicles*. Dr. Clark is the Director of the Laboratory for Autonomous and Intelligent Robotics. He has used robots to explore archeological sites in Malta.

From Tomas Bata University, Czech Republic …

On the 5th and 6th April 2011, the Department hosted Prof. Ing. Marek Kubalcik from the Department of Process Control, Tomas Bata University in Zlin, Czech Republic. Prof. Kubalcik delivered two presentations entitled *Library of Adaptive MIMO Controllers Based on Polynomial Methods*; and *Predictive Control of Multivariable Systems.*

From Bitly, U.S.A …

On the 22nd September 2011, the Department hosted Dr. Michael Dewar from *Bitly*, a rapidly emerging internet company in New York City, who delivered a presentation entitled *Building a Model of Organic Flow Traffic.*

7. Teaching activities

The teaching activities of the Department are currently focused on undergraduate degree courses in engineering. The Department is responsible for the delivery of several study-units within the B.Eng.(Hons) programmes in Electrical and Electronic Engineering, Mechanical Engineering and the B.Sc.(Hons) ICT course in Communications and Computer Engineering. It participates in the M.Sc. on Sustainable Environmental Resource Management which is jointly offered by the University of Malta and James Madison University (JMU) from the USA.

A selection of study units offered by the Department in 2010/2011		
SCE1201	Dynamic Systems and Signals 1	5 credits
SCE2111	Automatic Control Systems 1	5 credits
SCE2213	Automatic Control Systems 2	5 credits
SCE2110	Automatic Control Systems I	6 credits
SCE2210	Introduction to Control Systems	5 credits
SCE3113	Automatic Control Systems 3	5 credits
SCE3216	Automatic Control Systems 4	5 credits
SCE3112	Control Systems Technology and Automation	5 credits
SCE3101	Dynamic Systems and Signals 2	5 credits
SCE3205	Dynamic Systems and Signals 3	5 credits
PCE4001	Control Engineering	8 credits
SCI5005	Systems Thinking (in collaboration with JMU)	5 credits

8. Staff publications (Oct 2010 ~ Sept 2011)

M. K. Bugeja, S. G. Fabri, "Unscented Transform-based Dual Adaptive Control for Mobile Robots: Comparative Analysis and Experimental Validation", International Journal on Advances in Intelligent Systems, issn 1942-2679, Vol. 3, No. 3 & 4, 2010, 358:375, www.iariajournals.org/intelligent_systems.

P.C. McGuire, C. Gross, L. Wendt, A. Bonnici, V. Souza-Egipsy, J. Ormo, E. Diaz-Martinez, B.H. Foing, R. Bose, S. Walter, M. Oesker, J. Ontrup, R. Haschke, H. Ritter, "The Cyborg Astrobiologist: Testing a Novelty-Detection Algorithm on Two Mobile Exploration Systems at Rivas Vaciamadrid in Spain and at the Mars Desert Research Station in Utah", International Journal of Astrobiology, Vol. 9, pp. 11-27, 2010.

S.G. Fabri, K.P. Camilleri, T. Cassar, "Parametric Modelling of EEG Data for the Identification of Mental Tasks", in A. N. Laskovski, editor, Biomedical Engineering, Trends in Electronics, Communications and Software, InTech, 2011.

M.K. Bugeja, S.G. Fabri, "Dual Adaptive Neurocontrol of Mobile Robots using the Unscented Transform: Monte Carlo and Experimental Validation", in K. Madani, A. D. Correia, A. Rosa, J. Filipe, editors, Computational Intelligence, Vol. 343, pp. 237-250, Springer, 2011.

D. Freestone, P. Aram, M. Dewar, K. Scerri, D. Grayden, and V. Kadirkamanathan, "A data-driven framework for neural field modelling", NeuroImage, vol. 56, pp. 1043–1058, 2011.

O. Falzon, K.P. Camilleri, J. Muscat, "Common Spatial Patterns Using Analytic Signals for EEG-Based BCI's", presented at the Annual Meeting of the Society for Applied Neuroscience (SAN 2011), Thessaloniki, Greece, May 2011.

T. Cassar, K.P. Camilleri, S. Fabri, "Switching Kalman filters for EEG data segmentation", presented at the 3rd meeting of the Society of Applied Neuroscience (SAN 2011), Thessaloniki, Greece, May 2011.

L. Chetcuti Zammit, K. Scerri, M Attard, T Bajada and M Scerri, "Spatio-Temporal Analysis of Air Pollution Data in Malta" presented at Geocomputation 2011, UCL, London, June 2011.

S. Cristina, K.P. Camilleri, T. Galea, "Multi-View 3D Data Acquisition Using a Single Uncoded Light Pattern", 8th International Conference on Informatics in Control, Automation and Robotics, pp. 317-320, Noordwijkerhout, The Netherlands, July 2011.

P. J. Farrugia, J. C. Borg, K. P., Camilleri, "Exploiting Hand Sketching in Educating 'Mechanically Oriented' Engineering Students", International Conference on Engineering Design, Denmark, August 2011.

K. Scerri, M. Dewar, P. Aram, D. Freestone, D. Grayden, and V. Kadirkamanathan, "Balanced Reduction of an IDE-based Spatio-Temporal Model", Computation Tools 2011 : The Second International Conference on Computational Logics, Algebras, Programming, Tools, and Benchmarking, Rome, Sept. 2011.

9. Staff activities

Staff Member	**Activities**
Ms. A. Bonnici	Reviewer or committee member for international conferences and journals, including: - The Eurographics Workshop on Sketch Based Interfaces and Modelling. - Computer and Graphics Journal. Member of the Faculty PR and Marketing Focus Group and the Projects Exhibition sub-committee.
Ing. M. K. Bugeja	Reviewer for journal submissions, including: - IEEE Transactions on Systems, Man and Cybernetics (Part B). - International Journal of Systems Science. - Member of the Faculty's Ad hoc Committee on Assistant Lecturer Loading
Prof K. P. Camilleri	Chairman of the Support Staff Work Resources Committee. Project Leader (Biomedical Engineering Sub-project) of the ERDF Project "Strengthening of the Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities". Director, Centre for Biomedical Cybernetics. Reviewer for journal submissions, including: - IEEE Transactions on Image Processing. - IEEE Transactions on Signal Processing. - IEEE Signal Processing Letters.

- IEEE Computing in Science and Engineering.
- Journal of Electronic Imaging.
- Optical Engineering.

Member of the international programme committee of several international conferences, including:

- The Eighth IASTED International Conference on Biomedical Engineering (BioMED 2011).
- The Fourth International Workshop on Intelligent Interfaces for Human-Computer Interfacing (IIHCI-2011).
- The Fifth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2011).
- International Conference on Computer as a Tool (EUROCON 2011)
- IASTED International Symposia on Imaging and Signal Processing in Healthcare and Technology (ISPHT 2011)

FP7 Expert Project Proposal Evaluator

Ms. T. Cassar

Contact Person (Biomedical Engineering Sub-project) of the ERDF Project "Strengthening of the Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities".

Reviewer for journal submissions including:

- Journal of Selected Topics in Signal Processing.
- Journal of Biomedical Engineering and Control.
- IEEE Transactions on Biomedical Engineering

IEEE Malta Student Branch Adviser.

Prof S. G. Fabri

Head of the Department of Systems and Control Engineering.

Deputy Dean of the Faculty of Engineering.

Member on various University boards including the Board of the Institute for Sustainable Development, the Board of the Institute of Linguistics, the Faculty Board of Engineering, the MSc in Engineering Board of Studies (Chair), the B.Eng. Board of Studies, the Academic Work Resources

Committee, the Programme Validation Committee, the Research Fund Committee, the Faculty IT Affairs Subcommittee.

Leader of the ERDF Project "Modernizing the Control Systems Engineering Laboratory at the University of Malta".

Member on the Editorial Board of the International Journal of Systems Science.

Member on the Editorial Board of the International Journal on Advances in Intelligent Systems.

Reviewer for journal submissions, including:

- IEEE Transactions on Automatic Control
- IEEE Transactions on Systems, Man and Cybernetics
- IEEE Transactions on Signal Processing
- Journal on Advances in Intelligent Systems

Reviewer or committee member for several international conferences, including:

- International Conference on Advanced Engineering Computing and Applications in Sciences, 2011.
- IEEE Region 8 EuroCon, 2011.
- International Conference on Informatics in Control, Automation and Robotics, 2011.
- IFAC World Congress, 2011.

Member of the Administrative Council of the European Union Control Association (EUCA).

Dr. K. Scerri

Contact Person of the ERDF Project "Modernizing the Control Systems Engineering Laboratory at the University of Malta".

Member of the Faculty Board (from March 2011) and member of the Faculty PR group.

Member of the cross faculty *Transport Information Systems and TelemAtics* (TISTA) Research Group.

Reviewer for submissions to the IEEE Transactions on Signal Processing.

Advisory Chair, Session Chair and Reviewer of the Second

International Conference on Computational Logics, Algebras, Programming, Tools, and Benchmarking, Rome, Sept. 2011 and Reviewer for Medicom 2010

Collaborator with the Institute for Sustainable Development and the Faculty of ICT at the University of Malta on the project of Geoinformatics and Transport Modeling.

10. Prizes, awards and appointments

Appointment as Director:

Prof. Kenneth Camilleri was appointed by University Senate as the first director of the Centre for Biomedical Cybernetics. This new centre within the University of Malta is concerned with promoting and organizing multidisciplinary and interdisciplinary teaching, research, development and services in the field of cybernetics as applied to biological and biomedical systems.

Senior Membership of IEEE and SPIE:

Prof. Kenneth Camilleri was this year elected to the grade of Senior Member of the Institute of Electronic and Electrical Engineers (IEEE) on the basis of more than ten years of professional experience and achievements that demonstrate significant performance. Professor Camilleri was also elected to the grade of Senior Member of the Society for Photo-Optical Instrumentation Engineering (SPIE) on the basis of his participation in SPIE and his significant performance and professional experience in teaching, research and industry as related to the areas of image processing.

11. Participation in courses and meetings

BMVA Summer School on Computer Vision:

Ms. Stefania Cristina and Mr. Clifford DeRaffaele attended a 5-day course on Computer Vision organized by the British Machine Vision Association. The course was held between the 27th June and 1st July 2011 at the University of Manchester.

Research Visit at the Berlin Ultra-High Field Facility in Berlin:

Professor Kenneth Camilleri was invited for a research visit at the Berlin Ultra-High Field Facility (BUFF) of the Experimental and Clinical Research Center (ECRC) which was carried out in May 2011. BUFF is a magnetic resonance (MR) imaging facility providing an MR infrastructure for interdisciplinary imaging collaborations, such as the magnetic resonance research into cardiovascular and neurological imaging. During this visit, Professor Camilleri delivered a talk regarding the Department's signal processing research in brain-computer interfacing. Research links were established during this visit and the ground was laid to intensify the collaboration between BUFF and the Department at all levels including undergraduate student visits to the Berlin facility.

Research Visit at the University of Le Havre:

Ing. Marvin Bugeja was invited as a Visiting Researcher at the Electrical Engineering and Automation Research Group (GREAH) of the University of Le Havre in France. During this visit Marvin worked with Dr. Francois Guerin. Together they investigated a number of novel research avenues that integrate Dual Adaptive Dynamic Control and Visual Servoing Techniques for Wheeled Mobile Robots. They agreed to pursue, and already started, work on a number of such possibilities in the form of joint research projects between the two institutions.

12. Collaboration with third parties

International collaboration…

Dr. Kenneth Scerri collaborated with the Department of Automatic Control and System Engineering at the University of Sheffield, UK, the Department of Applied Physics and Applied Mathematics at Columbia University, USA and the Department of Electrical and Electronic Engineering at the University of Melbourne, Australia on Spatio-Temporal Modelling for Systems Biology.

Ms. Alexandra Bonnici collaborated with Dr. Patrick McGuire at the University of Chicago on the "Cyborg Astrobiologist" project.

Ing. Marvin Bugeja and Professor Simon G. Fabri collaborated with academics from the University of Le Havre in France on the investigation of intelligent control systems for mobile robots.

Popular media and outreach activities…

Dr. Kenneth Scerri, as part of the Faculty of Engineering PR group, gave several demonstrations on robotics to children attending the University summer school.

All staff members participated in various laboratory demonstrations in coordination with the Faculty's PR group for several University-wide events, and secondary and primary schools visits.

Professor Camilleri was invited to participate in the 'Health Strategy – Focus Group 5 – Design of devices/equipment, ICT applications' forum of the Malta Council for Science and Technology that was held in June 2011. During this meeting, the local resources applicable to this area were discussed and constraints that limit the faster development of this important sector in Malta were identified.

The research of Mr. Michael Sapienza, concerning the self-guidance of a mobile robot using vision, was compiled as a popular article in The Sunday Times of the 29th May 2011. In this article written by Mr. Sapienza and Professor Camilleri, the relevance of this work to daily life was presented together with a light description of the robot's newly found vision capabilities.