University of Malta
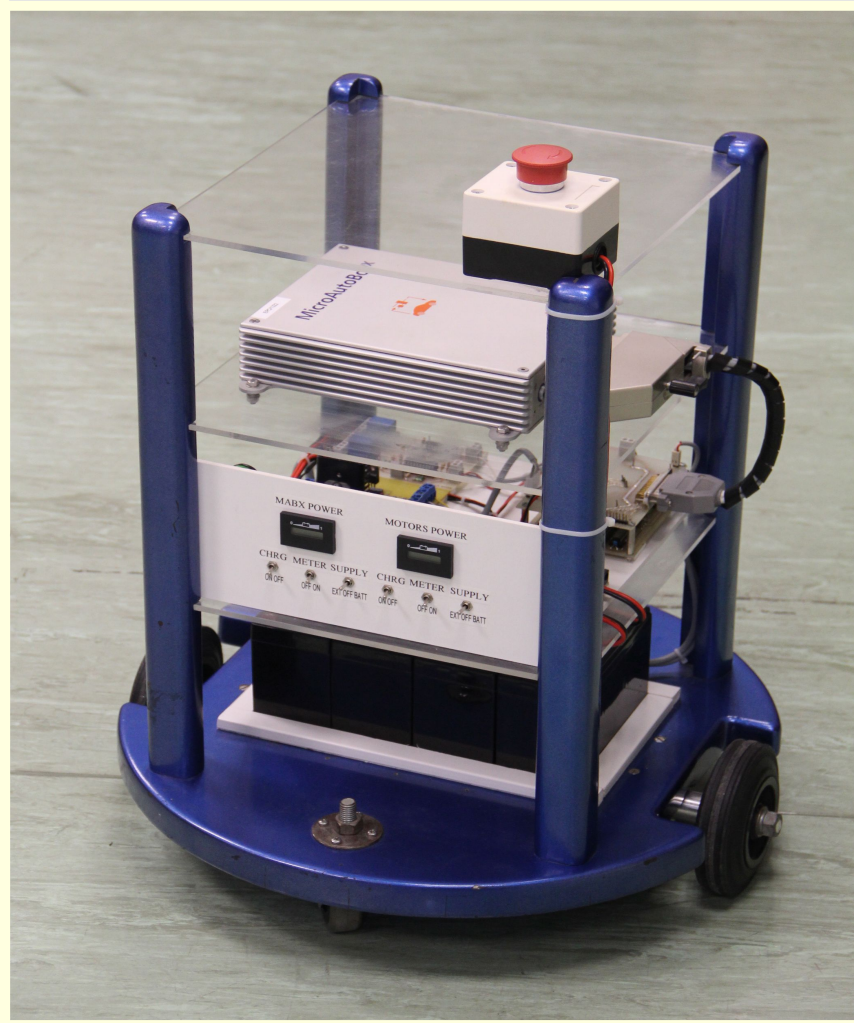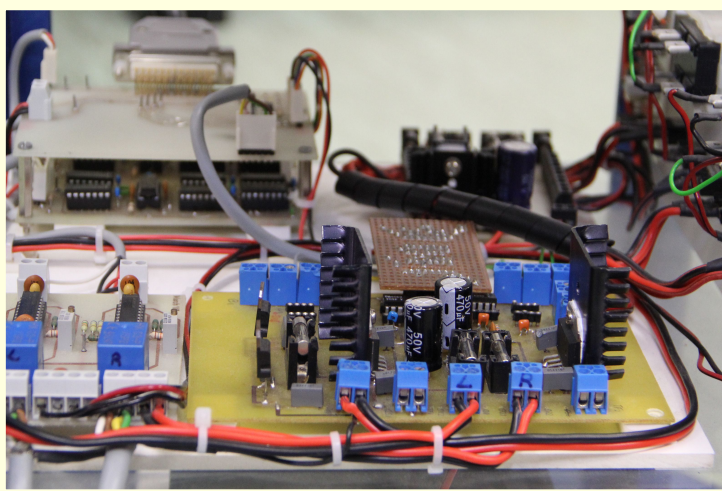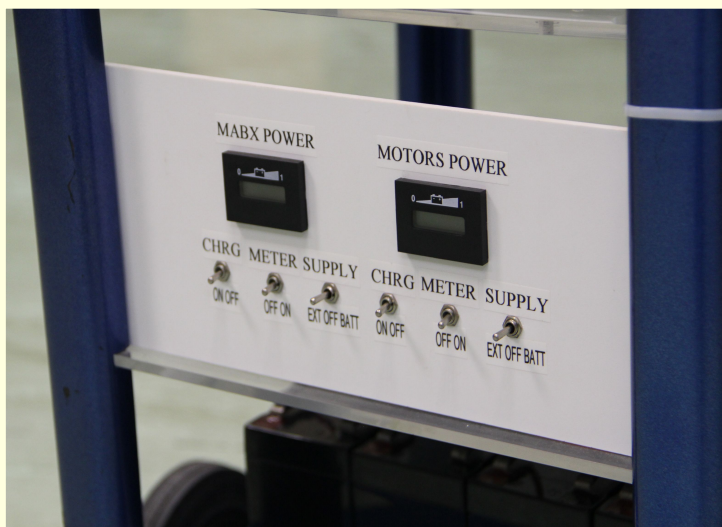*L-Università ta' Malta*

Annual Activity Report

2009 - 2010

Department of Systems and Control Engineering

SCE

Cover picture shows details of *Neurobot,* an autonomous robot.

Contents

1. Introduction

The end of academic year 2009/2010 sees the publication of this second edition of the annual activity report from the Department of Systems and Control Engineering. This past academic year was characterized by several successes and achievements for the Department.

On the research front, the department's staff coordinated and pursued several projects as described in Section 3 of the report. During this period, supervision of eight postgraduate research students fell under the responsibility of the department, in addition to ten final-year undergraduate student projects. A significant amount of papers was published in peer-reviewed journals and international conference proceedings.
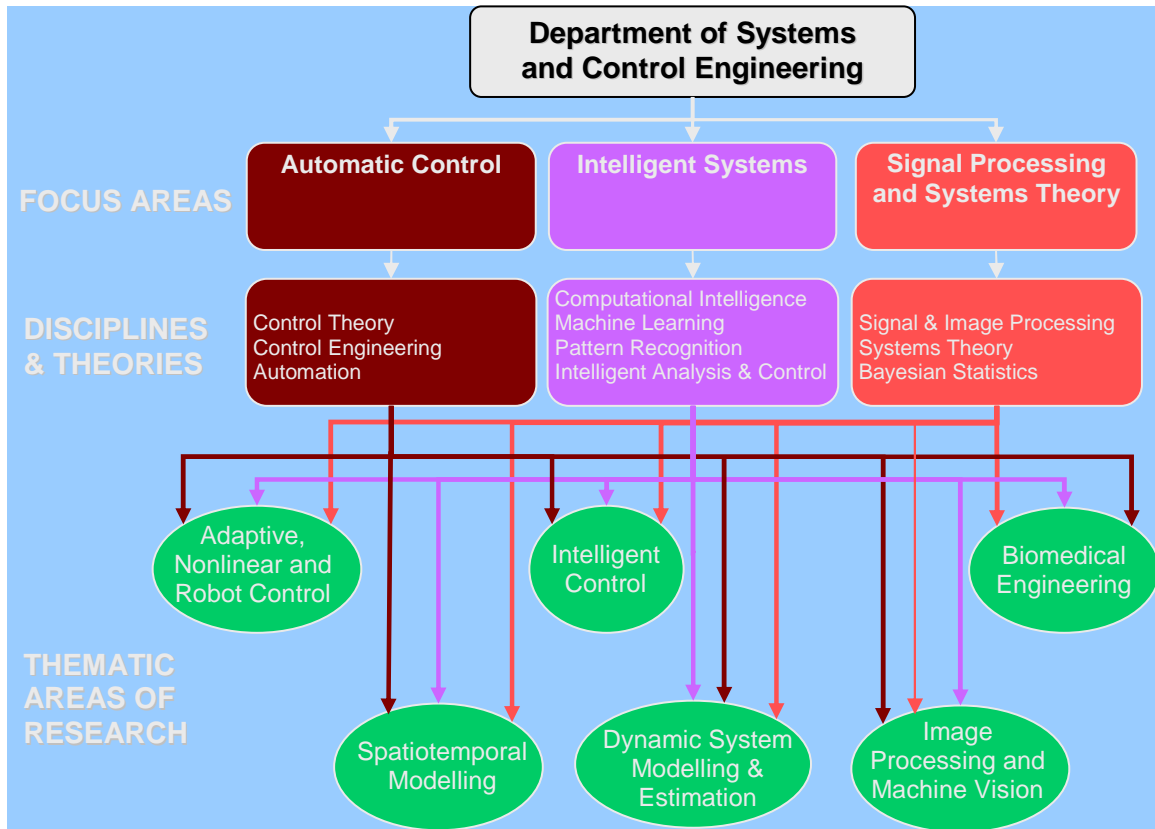
In particular two of these papers, dealing with intelligent control of mobile robots, obtained awards at two different conference events. Another staff member was awarded a doctorate from the University of Sheffield for his research on spatio-temporal system modelling. The department's links with international colleagues have led to joint authorship of papers, invited talks and research collaboration as detailed in Sections 6, 7 and 12 of the report.

Staff members contributed extensively to the execution of the department's two major infrastructural projects funded by the European Regional Development Fund for the setting up of a new Biomedical Engineering Laboratory and for modernizing the equipment infrastructure of the Control Systems Engineering Laboratory. Both these projects are now in their final stage of implementation and they are expected to be concluded by late 2010 or early 2011. These projects are described in more detail in Section 4.

At the end of this academic year, the Faculty of Engineering reverted the structure of all its undergraduate engineering degree courses from 3-year to 4-year programmes, as was the situation pre-2008. This decision contrasts with the department's preference for course structures comprising 3-year Bachelor's followed by 2-year Master's programmes. Nevertheless the department understands the complex issues which may have led Rectorate to insist on a 4-year undergraduate course. One hopes that this decision will not dampen the efforts and motivation for launching full-time, specialized Master courses in the near future. In any case, the department will do its utmost to contribute its best to the re-launched 4-year undergraduate course and to maintain high standards of teaching in the study-units falling under its responsibility.

I end this note by thanking all members of the department, both academic and support staff, for their contributions during the past academic year. I thank you for supporting me in my role as head of department and for maintaining a positive team spirit, a factor which I consider to be a key element for progress and growth.

Prof. Simon G. Fabri

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, MIEEE, ACIArb*

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

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*

Research Assistant:

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

Laboratory Officer II:

Mr. Noel Agius

**Executive Officer:**

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

3. Research activities

The Department attracts funding for research projects from various sources including EU research grants, Malta Government R&I grants, University research grants and industrial partners. The results and outcomes of these projects are published in peer-reviewed journals and international conference proceedings. The projects are led by academic staff members of the Department and include the participation of postgraduate students whose research contributions lead to the award of Doctoral or Master degrees. The following describes the main projects which have been in preparation, ongoing or concluded during academic year 2009/10.

3.1 Low Cost 3D Head Acquisition

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

This is an industry-academia collaborative project funded by a grant from the National RTDI Programme 2004. It is concerned with the development and implementation of a 3D object acquisition system, specifically for the acquisition of the 3D data of a person's head, with the added objective of low instrument cost and rapid acquisition. This project investigated how the difficulties arising from passive illumination may be overcome using multiple low-quality cameras and simple light projections. Novel algorithms were developed to exploit the data redundancy obtained from the multiple views and to super-resolve the depth map. The project is in its last phase, where the various components are being integrated and the performance specifications of the whole system are being established.
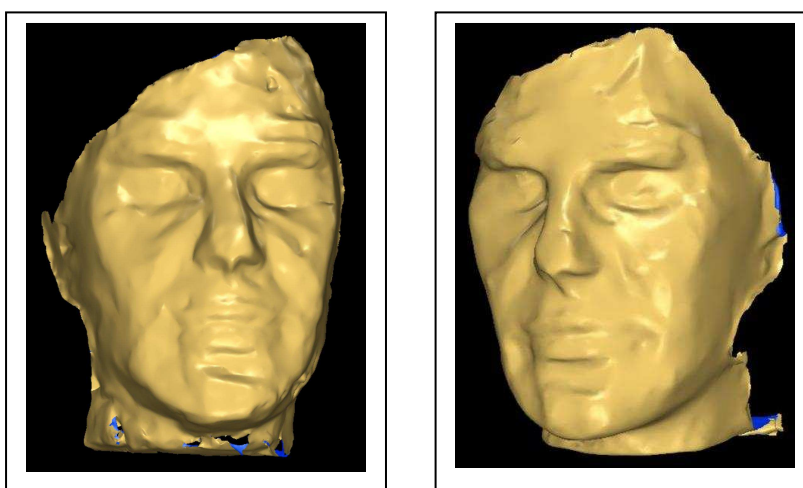
Surface maps of a mannequin head obtained using this 3D acquisition system.

## 3.2. Computational Intelligence Techniques for Control of Complex Systems

Main investigators: Prof. Simon G. Fabri and Ing. Marvin Bugeja.

This project, funded by the National RTDI Programme, was closed in late 2009. The project focused on the investigation and development of control algorithms based on advanced computational intelligence techniques, such as neural networks, in combination with advanced adaptive control theory, to effect versatile control of complex systems. In this manner, the controller is able to autonomously anticipate and handle plant faults, uncertainty and other complexities, such as nonlinearities, that cannot be modelled accurately or are unknown. This endows the controller with elaborate levels of performance and autonomy that are normally attributed to human *intelligence* such as the ability to adapt to unanticipated situations, to learn complex and previously unknown behaviour, and the capacity for automatically planning reliable control strategies. In essence, such automatic controllers attempt to mimic the intelligent traits and self-organising features found in nature.

In this work, particular emphasis was placed on the development of dual adaptive control techniques utilizing Kalman filter-based algorithms to train neural networks that are used to control *Neurobot*, a mobile robot that was developed by the Department. Preliminary studies on position control of a robotic arm were also carried out. The novel contributions from this research have been presented at several international conferences. Thirteen papers have been published in peer-reviewed engineering journals, book chapters and conference proceedings. Two of the conference papers were awarded best paper certificates.

Neurobot, the mobile robot.
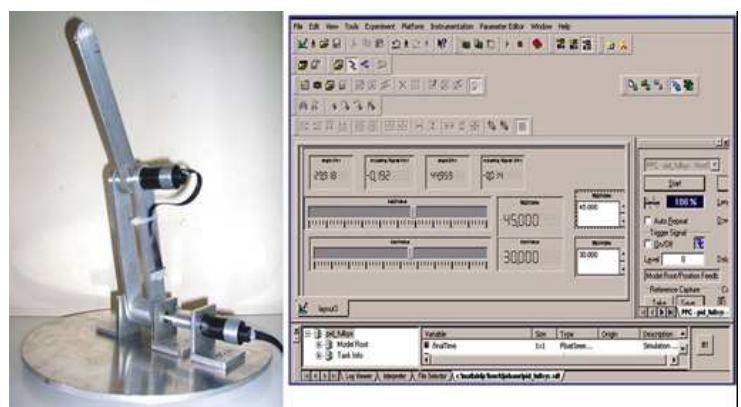
Motion control of a robotic arm.

3.3 Intelligent Control of Solar Water Heaters

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

This project, involving the collaboration of industry, commenced in October 2009. It is funded by the National R&I Programme 2008. The Department's input to the project aims to develop an intelligent, innovative and autonomous electronic controller to reduce the electrical energy consumption of solar water heaters when the temperature of the water needs to be bolstered by the electric heater due to insufficient solar exposure. The proposed controller will take into account various parameters which may affect the performance and utilization of the system. Such a controller should result in a much more efficient and effective control of the operation of the solar unit's backup heater.

3.4 Biopattern Network of Excellence

Main investigators: Ms. Tracey Cassar, Prof. Kenneth P. Camilleri, Prof. Simon G. Fabri, Dr. Joseph Muscat (Dept of Mathematics)

BIOPATTERN is a €4 million Network of Excellence project on biomedical signal analysis funded under the Sixth Framework Programme of the European Union. The University of Malta is one of 31 European partners in this network. The other partners range from universities to research institutes, health service providers and private companies. The University of Malta is represented by staff from the Department of Systems and Control Engineering (Prof. Simon Fabri, Ms Tracey Cassar and Prof. Kenneth Camilleri) and the Department of Mathematics (Dr Joseph Muscat), collectively functioning under the iBERG research group.

This project, which has now been closed, aimed to integrate those relevant elements of European research to make Europe a world leader in eHealth by developing intelligent computerized analysis of a person's biological and health profile. This analysis would be made remotely accessible to patients and clinicians where the information is applied to combat serious diseases such as cancer or Alzheimer's disease. The input of the Maltese group to this project is mainly concerned with the development of algorithms for computerized analysis of electrical brain signals (EEG) so as to localize the source of activity within the brain, thus permitting diagnosis of brain diseases such as epilepsy.

During the past year, our conclusive contributions to this project comprised the publication of two journal papers: one focussing on the discrimation of children with controlled epilepsy based on EEG analysis and another concerned with the analysis of independent components for healthy subjects as opposed to patients suffering from Alzheimer's disease.
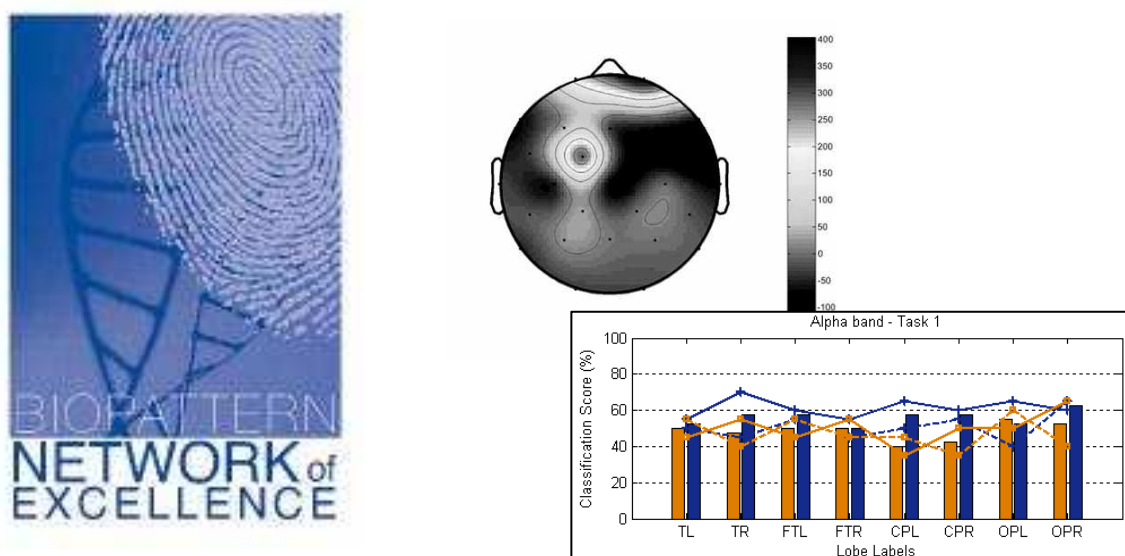
3.5 Early Stage Design for Rapid Prototyping

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 year, by means of collaboration with the Department of Metallurgy and Materials Engineering, the project was extended one step further such that the 3D virtual models created by the sketch-to-3D prototype tool were manufactured by means of laser cladding process.

This research has led to several international conference presentations, thirteen papers published in peer-reviewed engineering journals and conference proceedings, and a patent.
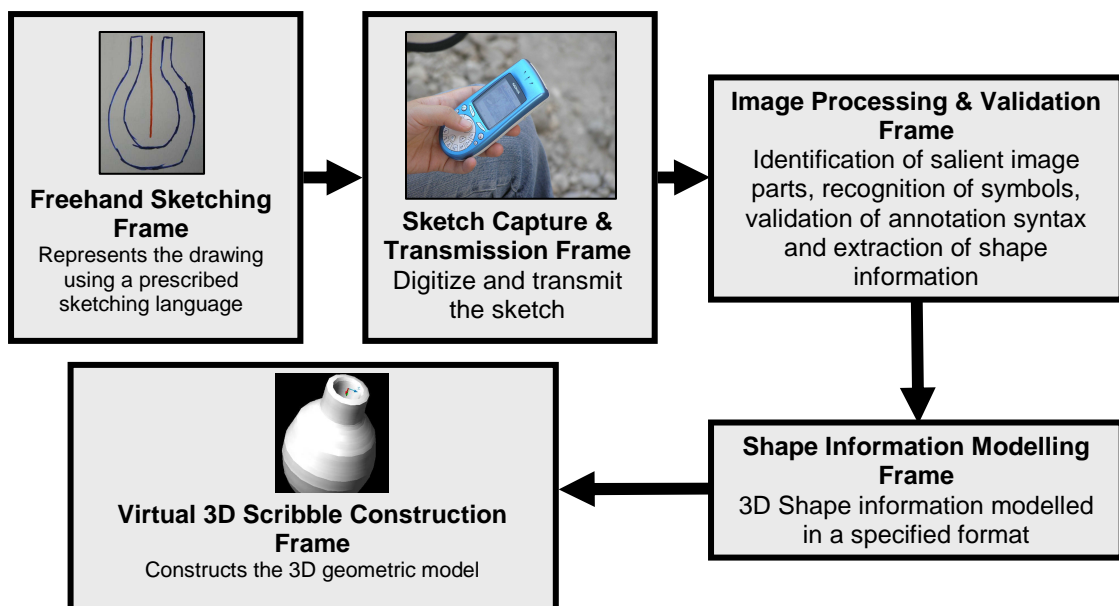
3.6 Brain Computer Interfacing

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 multiple modelling techniques to segment EEG data into different mental tasks, applying expert models to each task and using this knowledge in an online environment for brain computer interface applications.

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.
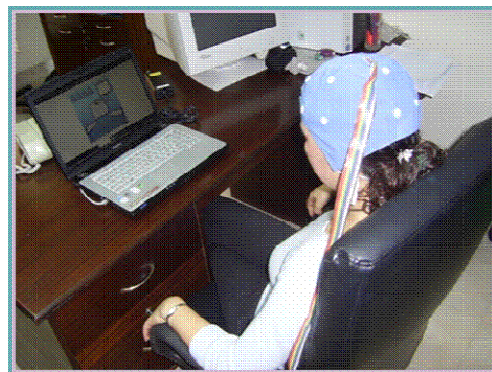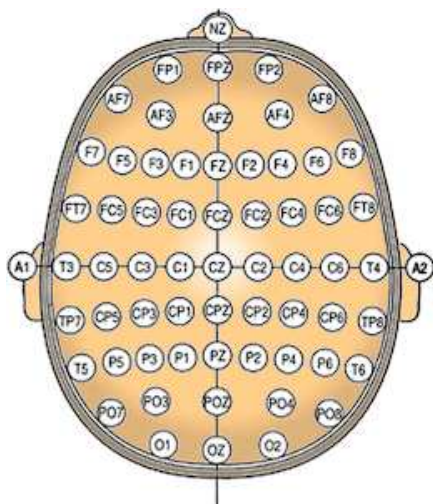
3.7 Spatio-temporal Modelling for Systems Biology

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 identifying the onset of an epileptic fit. Based on fault detection methods, it is foreseen to identify the onset of the fit and to develop control methods so as to suppress the fit either partially or completely.
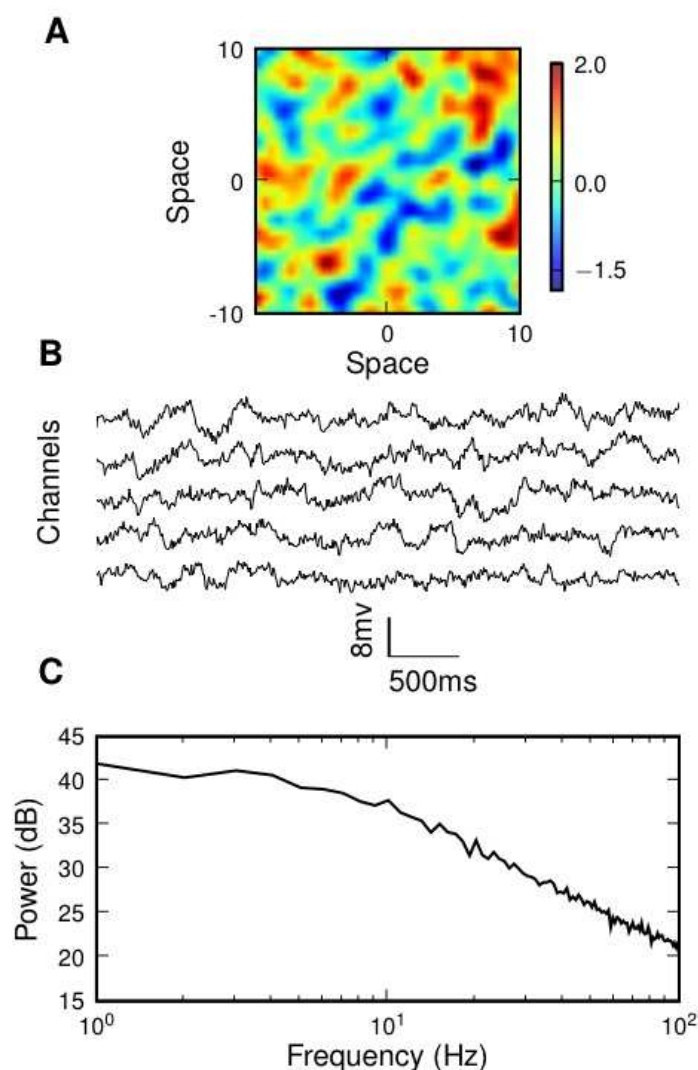
3.8 Spatio-temporal Analysis of Pollution Data

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 modelling of this data. The project deliverables include: results on the dispersal of various pollutant such as sulphur dioxide, nitrogen dioxide, benzene and ozone to identify main transport dynamics affecting the concentration of these pollutants; predictions on the future concentrations of these pollutants if current trends remain unchanged and simulation analysis of various possible remedies to identify better strategies for pollution control and sustainable development.
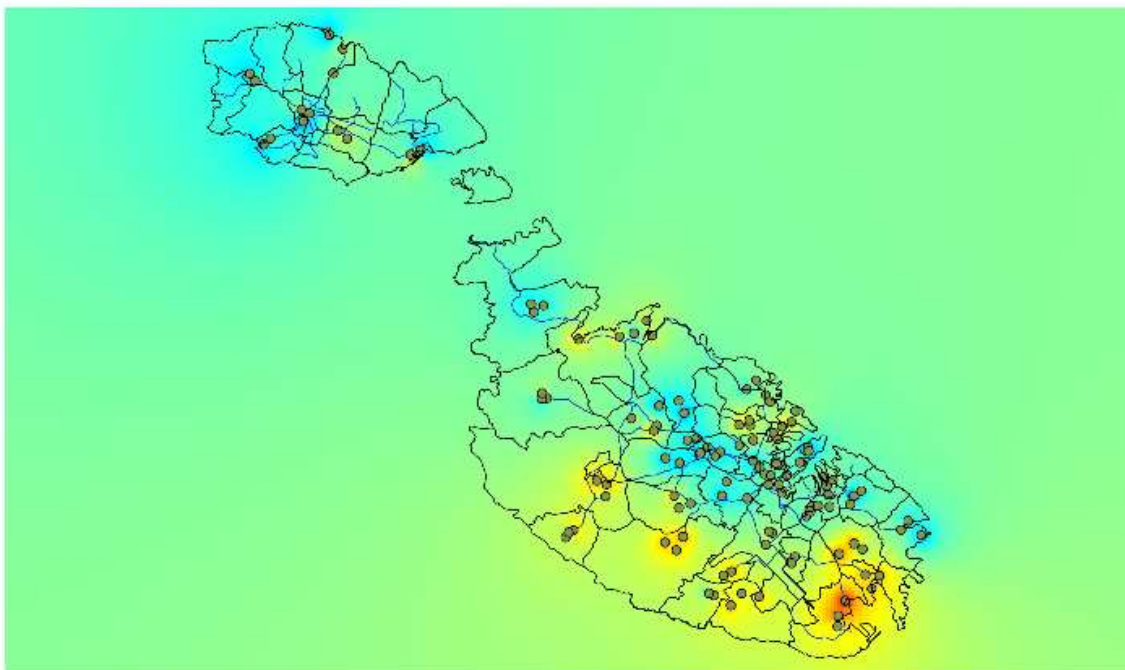
Correlation analysis for benzene measurements at Birzebbuga

3.9 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.

An example of such computer algorithms is the detection of novelty areas, whereby the algorithms are used to determine if the contents of a given image have been observed during earlier observations. This is of particular interest to the Astrobiologist as it can possibly indicate regions where new minerals are found, hence aiding the exploration process by allowing the astrobiologist to focus only on areas which are new. Given that in any exploration mission a large number of images may be taken, it would be considerably difficult and time consuming to carry out such comparisons manually. Thus the work carried out within this project can significantly improve the field missions.

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

Using a camera-phone to capture a "planetary" terrain   Processing of the image

3.10 Cognitive Vision for Sketch Understanding

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

The Early Stage Design for Rapid Prototyping focuses on developing tools that facilitate the creation of 3D models from simple sketches. While allowing for easier sketch-to-3D transition, the tools being developed by this project require some form of prescribed sketching language such that design intent can be unambiguously inferred as the desired 3D shape.

Human interpretation of natural sketches however, does not require such disambiguation and the designer intent can be perceived quite easily from the sketch, such as that shown in the figure below. Rather than being interested in the creation of 3D models, this project focuses on the human interpretation of natural sketches, identifying what cues (such as shading and line weight among others) are used by designers to portray the desired intent and how these are used by the observer to interpret the drawing, given that a single sketch may contain multiple cues.

Although interpretation of sketches seems to be a trivial task since human interpretation can easily perceive the intended 3D form, computer interpretation of the 2D drawing is non-trivial since any 2D drawing may be considered a valid projection of a number of 3D shapes as shown in the diagram. The fact that human observers tend to agree on a single interpretation of the drawing, indicates that human observers tend to look for certain shape properties when interpreting the drawing.

The scope of this project is to develop a means to provide initial interpretation of the depth order of the various components within the sketch. This, while not providing a complete 3D model of the object in the sketch, will provide an important step in making 3D modelling more human centred.
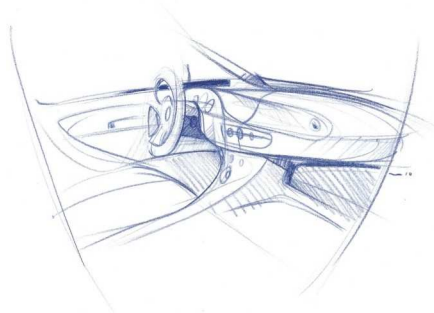
Sketch drawn by Micheal G. Cox
http://www.coroflot.com/michaelgcox/sketches/
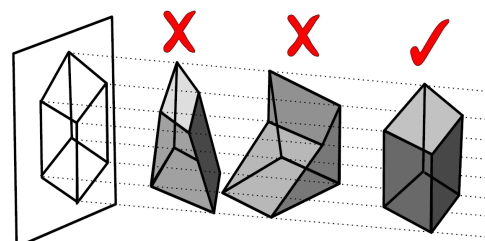
Optimization techniques select the most valid interpetation from an infinite numer of projections

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3.11 Vision for Real-time Autonomous Mobile Robot Guidance

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

The objective of this project is to develop a vision system for a mobile robot that may be used to guide the robot in an unknown indoor or outdoor environment and allow the robot to explore the environment autonomously. Robots that make use of vision may be able to extract long-range information and high-level semantics from the environment and direct their movement accordingly, affording more intelligent robot guidance. Currently this work is investigating the potential of a real-time mobile robot vision system that makes use of a relatively low-quality monocular camera. The technique that is currently being explored analyses image features and uses an iterative probabilistic framework to identify traversable ground area and to direct the robot towards open traversable areas avoiding static or dynamic obstacles.

3.12 Segmentation and Modelling of Vertebrae from 2D Medical Images

Main investigators: Prof. Kenneth P. Camilleri, Mr Owen Falzon, Dr. Z. Sant (Dept of Mechanical Engineering)

The objective of this project is to develop computational tools to segment and model vertebrae from CT/MRI scans. Automated segmentation of organs from medical images and subsequent 3D reconstructions of these organs can significantly aid medical diagnosis. 3D models allow a better visualization than 2D scans, and can constitute a very useful tool for analysis. Robust segmentation procedures are essential to obtain reliable 3D models from 2D images. However, carrying out segmentation manually is tedious and time-consuming; automated segmentation techniques can greatly reduce the time delay and effort involved to generate 3D models from acquired CT/MRI scans. Our intention is to explore image processing methods and computational intelligence techniques that can be employed to develop algorithms for the automated segmentation and 3D reconstruction of vertebrae from medical images.
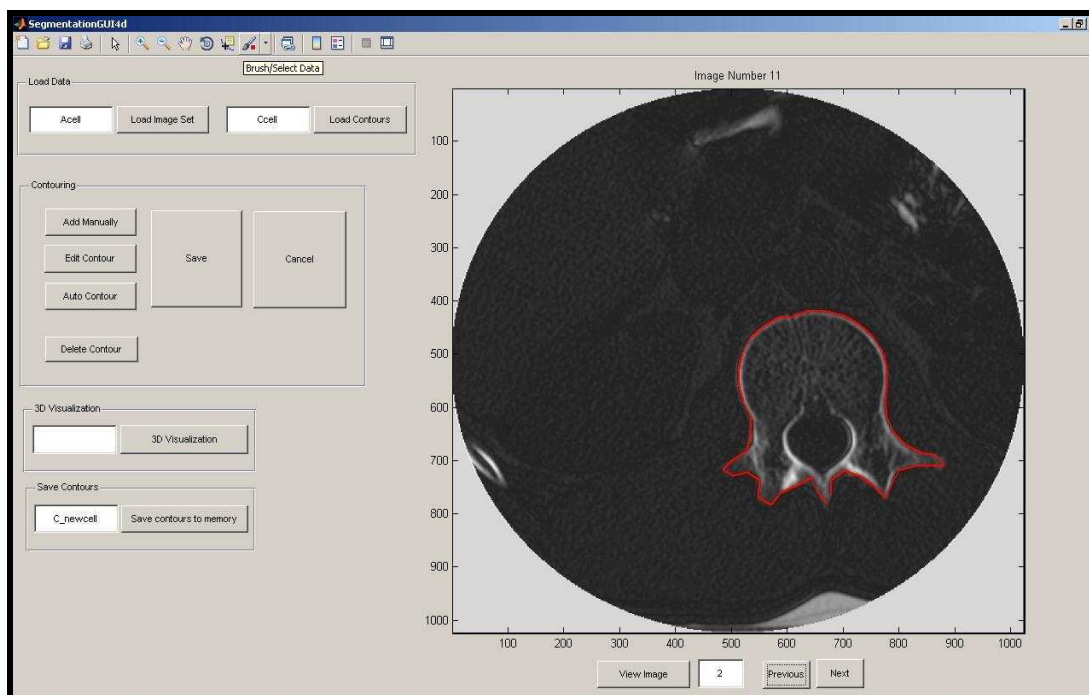
A screenshot of the graphical user interface of the computational tool that is under development showing the identified boundary in this CT slice.

4. Infrastructural projects:

The Department of Systems and Control Engineering, benefiting from more than €1 Million from the European Regional Development Fund (ERDF) under the Cohesion Policy Programme 2007-2013, is investing a great deal of time and effort of each of its staff members to two major infrastructural projects, namely, the modernizing and upgrading of the Control Systems Engineering Laboratory and the setting up of a new Biomedical Engineering Laboratory.

The Control Systems Engineering Laboratory services the University's practical teaching and research activities in the area of Automatic Control Engineering and is being upgraded by the acquisition and installation of state-of-the-art equipment to be used for 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 new Biomedical Engineering Laboratory consolidates the ongoing biomedical engineering research activities of the Department where engineering expertise is applied to medical, health and rehabilitation problems. Intended mainly for advanced teaching and research, this laboratory is being equipped with a variety of equipment that facilitates the acquisition and analysis of data from the human body, allowing researchers to develop new tools and techniques that will assist physicians and health practitioners in their duties in favour of a better health care.

These infrastructural 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 postgraduate research students. These 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.
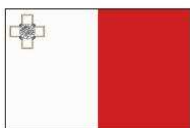
5. Student Projects and Supervision

5.1 B.Eng. students

Project title	Student	Supervisor
Person Identification using Brain Signals	Bezzina Allister	Ms. T. Cassar
Simulation Models for Control using the Modelica/Dymola Environment	Cassar Matthew	Ing. M. Bugeja
Control of a Robotic Finger using Shape Memory Alloy Actuation	Cauchi Mario	Prof. S. Fabri
Simulation of Flight Control for an autonomous Helicopter	Chetchuti Zammit Luana	Dr. K. Scerri
Active Control of Vibrations in a Cantilever Beam	Gauci Wanda	Prof. S. Fabri
Nonlinear Control of a Rotational Inverted Pendulum	Micallef Martin	Ing. M. Bugeja
Robot Manipulator Control	Muscat Raymond	Prof. S. Fabri
Model Predictive Control of a Ball Balancing System	Spiteri Peter	Dr. K. Scerri
Classification of Physical Movements Based on Human EEG Data	Vella Ingrid	Dr. K. Scerri
Implementation and Control of a Ball and Plate System	Vella Minette	Ing. M. Bugeja

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
Fusion of stereo image data from multiple views for 3D data acquisition	Cristina Stefania	Prof. K. Camilleri
Intelligent control of solar water heaters	Debono Reuben	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
The application of signal modeling and computational intelligence techniques for the analysis of EEG data	Falzon Owen	Prof. K. Camilleri

6. External lecturers and visitors

From the University of Sheffield, United Kingdom …

On the 26th October 2009, the Department hosted Mr. Andrew Zammit Mangion, a PhD student at the Department of Systems and Control Engineering in the University of Sheffield, who presented a talk on *Parameter Identification of Spatiotemporal Systems Governed by SPDEs*. This talk was immediately followed by a 2nd presentation from Dr. Kenneth Scerri, the Department's expert on spatiotemporal systems, who discussed *Spatial Sampling and Reconstruction of Spatiotemporal Systems.*

From the University of Le Havre, France…

On the 5th November 2009, the Department hosted two academics from the University of Le Havre, France who delivered lectures to 4th year B.Eng. Electrical Engineering students taking the Control Engineering elective study-unit. Dr. Francois Guerin presented a detailed account of research projects taking place within the Electrical Engineering and Automation Research Group at Le Havre, and Dr. Florence Lecroq delivered a lecture on Programmable Logic Control systems. This visit was funded by the EU Socrates-Erasmus programme.

From the University of Guanajuato, Mexico …

On the 25th May 2010, the Department hosted Professor Yuriy Shmaliy from the University of Guanajuato in Mexico who presented a talk entitled *Discrete-time Optimal and Unbiased FIR Estimation of State Space Models*.

From the University of Chicago, USA …

On the 2nd July 2010, the Department hosted Dr. Patrick McGuire from the Department of Geophysical Sciences of the University of Chicago, USA who delivered a presentation entitled *The Cyborg Astrobiologist: Teaching computers to find uncommon or novel areas of geological scenery in real-time.*

7. Staff publications (Oct 2009 ~ Sept 2010)

M. K. Bugeja, S. G. Fabri, "A novel dual adaptive neuro-controller based on the unscented transform for mobile robots", Proceedings of the International Conference on Neural Computation (ICNC 2009), Madeira, Portugal, October 2009. [Awarded best student paper prize]

M. K. Bugeja, S. G. Fabri, "Dual-adaptive computer control of a mobile robot based on the unscented transform", Proceedings of the Third International Conference on Advanced Engineering, Computing and Applications in Science - ADVCOMP 09, Sliema, Malta, October 2009. [Awarded Best Paper prize]

T.A. Cassar, K.P. Camilleri, S.G. Fabri, 'Order estimation of computational models for dynamic systems with application to biomedical data', Proceedings of the Third International Conference on Advanced Engineering Computing and Applications in Sciences, ADVCOMP 2009, Malta, October 2009.

O. Falzon, K.P. Camilleri, 'An algorithm for brain computer interfacing based on phase synchronization spatial patterns', Proceedings of the Third International Conference on Advanced Engineering Computing and Applications in Sciences, ADVCOMP 2009, Malta, October 2009.

A. Bonnici, K.P. Camilleri, 'Scribble vectorization using concentric sampling circles', Proceedings of the Third International Conference on Advanced Engineering Computing and Applications in Sciences, ADVCOMP 2009, Malta, October 2009.

T.A. Cassar, K.P. Camilleri, S.G. Fabri, 'Three-mode classification and study of AR pole variations of imaginary left and right hand movements', Proceedings of the 7th IASTED Conference on Biomedical Engineering, BioMed 2010, Innsbruck, Austria, February 2010.

O. Falzon, K.P. Camilleri, 'Reference signal effects on task discrimination algorithms for EEG-based BCI's', Proceedings of the 7th IASTED Conference on Biomedical Engineering, BioMed 2010, Innsbruck, Austria, February 2010.

T. Cassar, K.P. Camilleri, S.G. Fabri, 'Order estimation of multivariate ARMA models', IEEE Journal of Selected Topics in Signal Processing, Vol. 4, No. 3, pp.494 - 503, June 2010.

V. Sakkalis, T. Cassar, M. Zervakis, C. D. Giurcaneanu, C. Bigan, S. Micheloyannis, K.P. Camilleri, S.G. Fabri, E. Karakonstantaki, K. Michalopoulos, 'A Decision Support Framework for the Discrimination of Children with Controlled Epilepsy based on EEG Analysis', Journal of NeuroEngineering and Rehabilitation, 7:24, June 2010.

B.W. Jervis, S. Belal, T. Cassar, M. Besleaga, C. Bigan, K. Michalopoulos, M. Zervakis, K. Camilleri, S. Fabri, 'Waveform Analysis of Non-oscillatory Independent Components in Single-Trial Auditory Event-Related Activity in Healthy Subjects and Alzheimer's Disease Patients', Current Alzheimer Research, Vol. 7, No. 4, pp. 334-347, June 2010.

O. Falzon, K.P. Camilleri, J. Muscat 'Complex-Valued Spatial Filters for Task Discrimination', Proceedings of the 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC 2010, Buenos Aires, Argentina, August 2010.

A. Bonnici, C. Gross, P. C. McGurie, J. Ormo, S. Walter and L. Wendt, 'The Cyborg Astrobiologist: Compressing Images for the Matching of Prior Textures and for the Detection of Novel Textures' European Planetary Science Congress 2010, Rome, September 2010.

8. 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, USA.

A selection of study units offered by the Department in 2009/2010		
SCE1101	Continuous-time Dynamic Systems and Signals I	5 credits
SCE1202	Continuous-time Dynamic Systems and Signals II	5 credits
SCE2111	Automatic Control Systems I	5 credits
SCE2102	Discrete-time Dynamic Systems and Signals I	5 credits
SCE2213	Automatic Control Systems II	5 credits
SCE2110	Automatic Control Systems I	6 credits
SCE2210	Introduction to Control Systems	5 credits
PCE3001	Control Systems 3	4 credits
PCE3002	Control Systems 4	4 credits
PCE3506	Control of Machines and Processes	4 credits
PCE4001	Control Engineering	8 credits

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.
Prof K. P. Camilleri	Member on various University boards including Faculty Board of Engineering, Board of Studies of M.Sc. (Engineering) Degree Programme, chairperson of the Faculty Research Ethics Committee and of the Non-academic Work Resources Committee. Project Leader (Biomedical Engineering Sub-project) of the ERDF Project "Strengthening of the Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities". Reviewer for journal submissions, including: - IEEE Transactions on Image Processing. - IEEE Computing in Science and Engineering. - Optical Engineering. Member of the international programme committee of several international conferences, including: - The Seventh IASTED International Conference on Biomedical Engineering (BioMED 2010). - The Third International Workshop on Intelligent Interfaces for Human-Computer Interfacing (IIHCI-2010).

	- The Fourth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2010). - The International Conference on Pattern Recognition, 2010 (ICPR 2010). - The Fifteenth IEEE Mediterranean Electrotechnical Conference (MELECON 2010). PhD external examiner at the University of the Basque Country, Spain.
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 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 Faculty Postgraduate Subcommittee, 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 Senate Research Methods 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. Reviewer for journal submissions, including: - IEEE Transactions on Automatic Control

-   IEEE Transactions on Systems, Man and Cybernetics
-   IEEE Transactions on Neural Networks
-   IEEE Transactions on Robotics

Reviewer or committee member for several international conferences, including:
-   International Conference on Advanced Engineering Computing and Applications in Sciences, 2010.
-   7th IFAC Symposium on Intelligent Autonomous Vehicles, 2010.
-   International Conference on Informatics in Control, Automation and Robotics, 2010.
-   12th Mediterranean Conference on Medical and Biological Engineering and Computing, 2010.
-   15th IEEE Mediterranean Electrotechnical Conference, 2010.

Member of the IEEE Region 8 Student Paper Contest Committee (2010).

Ph.D. external examiner at the University of Southampton, United Kingdom.

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".

Reviewer for submissions to the IEEE Transactions on Signal Processing.

Member of the Technical Programme Committee of the Fourth International Conference on Advanced Engineering Computing and Applications in Sciences, ADVCOMP 2010.

10. Prizes, awards and appointments

Best student paper award:

Ing. Marvin Bugeja was awarded the best student paper prize in the 2009 International Conference on Neural Computation held in Portugal last October. The paper, co-authored with Prof. Simon Fabri, is entitled "A novel dual adaptive neuro-controller based on the unscented transform for mobile robots". It reports some of the latest design and theoretical developments from Marvin's doctoral studies.

Best paper prize:

The paper entitled "Dual-adaptive computer control of a mobile robot based on the unscented transform" by Ing. Marvin Bugeja and Prof. Simon Fabri was awarded one of the best paper prizes in the 2009 International Conference on Advanced Engineering, Computing and Applications in Science. The conference was held in Malta in October 2009. This paper reports novel experimental results on mobile robot control.

IEEE outstanding branch counselor award:

Prof. Simon Fabri was awarded the 2009 Outstanding Branch Counselor Award from the IEEE. This award recognizes Prof. Fabri's contributions as counselor of the IEEE Malta Student Branch from 2003 until 2008.

Finalist at Campus Party Europe Project Forum:

The department's project on mobile robotics was selected as one of 20 projects for presentation in the final session of the Campus Party Europe Project Forum held in Madrid in April 2010. This activity was organized by the Spanish Ministry for Science and Innovation and supported by the European Commission.

Promotion:

The Council of the University of Malta promoted Dr. Kenneth Scerri to the grade of Lecturer with effect from March 2010.

Doctoral degree:

In July 2010, The University of Sheffield in the United Kingdom conferred the degree of Ph.D. on Kenneth Scerri for successfully defending his doctoral thesis entitled "A Systems Approach to Spatio-temporal Modelling".

Appointment as committee member:

In September 2010, Prof. Simon G. Fabri was elected as member of the Administrative Council of the European Union Control Association (EUCA).

11. Participation in courses and meetings

Seminar on computerized interpretation of 3D sketches at the Digital Arts Expo 2009:

Ms. Alexandra Bonnici, Prof. Kenneth Camilleri and Dr. Philip Farrugia (DME Department) delivered a one-hour seminar entitled "Can a computer perceive 3D form from a hand-drawn sketch?". The seminar, which took place on the 4th November as part of the Digital Arts Expo 2009, disclosed the R&D work carried out by this team over a period of more than eight years and included videos demonstrating applications of sketch interpretation computer tools. A practical solution to this problem was available for live demonstration before and after the seminar. Participants were invited to create their own 3D models after a brief tutorial on how to use the tool. A video demonstration illustrating the practical use of the proposed solution was available for the duration of the Expo.

The stand on 3D sketching at the DA Expo 2009

Invited talk at the University of the Basque Country:

Prof. Kenneth Camilleri was invited to deliver a talk on the Department's research on computer vision at the UBC Workshop of Computational Intelligence Trends and Methods at the University of the Basque Country, Spain in December 2009. The topic selected for the talk was the research carried out by Ms Alexandra Bonnici and Prof. Camilleri on the perceptual simplification of paper-based scribbles for 3D form generation.

Exploratory meeting with Technoline Ltd:

On the 11th February 2010, the Department hosted a high-level delegation from Technoline Ltd with the objective of exploring research and technical collaboration between the two sides. The exploratory meeting was preceded by a tour of the Department's laboratories and its main research activities.

Training course on Capacity Building for Structural Fund Stakeholders – Introduction to payment procedures, guidelines to VAT:

Dr. Kenneth Scerri attended a training programme organized by the Planning and Priorities Coordination Division of the Office of the Prime Minister on Capacity Building for Structural Fund Stakeholders. The training sessions were held in March 2010 at the Intercontinental Hotel in St. Julians.

Presentation and participation at the Campus Party Europe Project Forum:

Dr. Kenneth Scerri presented the department's research on mobile robotics at the final session of the Campus Party Europe Project Forum held in Madrid in April 2010. This activity was organized by the Spanish Ministry for Science and Innovation and supported by the European Commission.

Invited Talk at the Student Professional Awareness Conference:

Prof. Kenneth Camilleri was invited to deliver a talk on postgraduate opportunities to the Student Professional Awareness Conference (SPAC 2010) organized by the IEEE Student Branch (Malta).

Training on Motion Capture Analysis System:

Prof. Kenneth Camilleri, Mr. Owen Falzon and Ms. Tracey Cassar attended a training course on the Motion Capture Analysis System which was procured through the ERDF project for the setting up of a Biomedical Engineering Laboratory. The training session was held on the 17th June 2010 at the Department's Biomedical Engineering Laboratory. It was delivered by a representative from Vicon.

Training on Body Pressure Measurement System:

Prof. Kenneth Camilleri, Mr. Owen Falzon and Ms. Tracey Cassar attended a training course on the Body Pressure Measurement System which was procured through the ERDF project for the setting up of a Biomedical Engineering Laboratory. The training session was held on the 30th June 2010 at the Department's Biomedical Engineering Laboratory. It was delivered by a representative from Tekscan.

BMVA Summer School on Computer Vision:

Ms. Alexandra Bonnici, Mr. Owen Falzon, Mr. Michael Sapienza and Mr. David Agius attended a 5-day course on Computer Vision organized by the British Machine Vision Association. The course was held between the 12th and 16th July 2010 at Kingston University, London.

Training on FLIR Thermal Camera:

Prof. Kenneth Camilleri, Mr. Owen Falzon and Ms. Tracey Cassar attended a training course on the FLIR Thermal Camera which was procured through the ERDF project for the setting up of a Biomedical Engineering Laboratory. The training session was held on the 22nd September 2010 at the Department's Biomedical Engineering Laboratory. It was delivered by a representative from FLIR.

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.

Professor Simon G. Fabri and Ing. Marvin Bugeja collaborated with academics from James Madison University, USA on the preparation and delivery of study-units for the first run of the International Masters Degree Programme in Sustainable Environmental Resource Management (SERM).

Popular media…

Professors Simon G. Fabri and Kenneth P. Camilleri were interviewed on the radio programme 'Research Matters' on Campus FM where they discussed the Department's research activities and initiatives.

The Department's staff members and several of their students participated in four episodes of the TV programme *Laboratorji.* The episodes, filmed in the [Biomedical Engineering Laboratory](#) and the [Control Systems Engineering Laboratory](#), exposed in some detail the several projects and research activities taking place in the Department.

Professor Kenneth P. Camilleri, Ms Tracey Cassar and Mr Owen Falzon were interviewed by journalist Ms Cynthia Busuttil of the Times newspaper where they discussed the Department's research activities in image processing and brain-computer interfacing together with various other issues challenging research in Malta. A summary of the interview was published in the Times issue of the 1st of May 2010.

Ms Stefania Cristina and Professor Kenneth P. Camilleri were interviewed by TV and radio presenter Mr Manwel Cassar on the nature of research in the Department and specifically on an eye-gaze tracking system that was developed in the Department. Interviews were aired in a TV and radio programme on Education 22 channel and on radio RTK respectively in May 2010.