

# **DEPARTMENT OF SYSTEMS AND CONTROL ENGINEERING**

## **ACTIVITY REPORT**

**October 2011 ~ September 2012**



**University of Malta**



**Department of Systems and Control Engineering**

# Contents

1. INTRODUCTION	2
2. STAFF MEMBERS	4
3. RESEARCH ACTIVITIES	5
3.1 LOW COST 3D HEAD ACQUISITION	5
3.2 NONLINEAR CONTROL, ADAPTIVE CONTROL AND ROBOTICS	6
3.3 SIGNAL PROCESSING METHODS FOR BRAIN COMPUTER INTERFACING	7
3.4 REAL-TIME BRAIN-COMPUTER INTERFACE PLATFORM	8
3.5 SPATIO-TEMPORAL MODELLING FOR SYSTEMS BIOLOGY	9
3.6 SPATIO-TEMPORAL ANALYSIS OF POLLUTION DATA	10
3.7 COGNITIVE VISION FOR SKETCH UNDERSTANDING	11
3.8 VISION FOR REAL-TIME AUTONOMOUS MOBILE ROBOT GUIDANCE	12
4. STUDENT PROJECTS AND SUPERVISION	13
4.1 B.ENG. STUDENTS	13
4.2 M.SC. STUDENTS	14
4.3 M.PHIL / PH.D CANDIDATES	14
5. EXTERNAL LECTURERS AND VISITORS	15
6. TEACHING ACTIVITIES	16
7. STAFF PUBLICATIONS (OCT 2011 ~ SEPT 2012)	17
8. STAFF ACADEMIC ACTIVITIES	18
9. PRIZES, AWARDS AND APPOINTMENTS	21
10. PARTICIPATION IN COURSES, MEETINGS AND OVERSEAS VISITS	22
11. COLLABORATION WITH THIRD PARTIES	23

## 1. Introduction

This year's Annual Activity Report, the fourth one in the series, has a special personal significance: it is the last edition which I am compiling as Head of the Department of Systems and Control Engineering. My term as head of department will come to an end in a few days' time when this role will be handed over to my esteemed colleague Professor Kenneth Camilleri.

It has been an honour and a pleasure to lead the department since its inception for the last five years. Thanks to the excellent support of all academic and non-academic staff attached to the department, we have grown and achieved a lot. We are now a strong team of six academic and three non-academic staff members, we run two major state-of-the-art laboratories equipped with resources financed through EU structural funds, we have an enthusiastic group of postgraduate research students, a strong track record of peer reviewed publications and a significant amount of study-units offered to different course programmes at the University of Malta. These achievements reflect the dedication, commitment and team spirit characterizing the ethos of the department.

Focusing particularly on the last academic year, one notes a wide spectrum of research activities falling within the area of Systems and Control Engineering as detailed in Section 3 of this report. This has led to several peer-reviewed publications in renowned journals and international conference proceedings. One staff member was awarded a doctorate for his research on neural adaptive control as applied to mobile robots. Other staff members are well underway with their doctoral research programmes and expected to conclude their work in the near future.

Links with international institutions, often aimed at strengthening teaching and research collaborations, have also been ongoing as detailed in Sections 5, 10 and 11 of the report. A notable event, which left a positive impression of the department in the news and the local press, was the Prime Minister's inauguration of the Biomedical Engineering Laboratory and the Control Systems Engineering Laboratory last October. Impressive snapshots of these two laboratories are shown on the next page. Several other initiatives for outreach of the department to the external public are listed in Section 11.

I end this introduction by urging you to read patiently through the report to understand better what "makes us tick" as a department and why we find Systems and Control Engineering so exciting. Above all, I take this opportunity to thank the department's members of staff for their continuous dedication and support. This helped me immensely in my role as Head of Department during the past five years and it has truly been a pleasure working with you. I am convinced that the future will see further progress in support of the department's mission to spread and create knowledge in the exciting area of Systems and Control Engineering.

24<sup>th</sup> September 2012

**Prof. Simon G. Fabri**  
**Head of Department**



The newly refurbished Control Systems Engineering Laboratory



The new Biomedical Engineering Laboratory

## 2. Staff Members

### Associate Professors:

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

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*

Dr. Ing. Marvin K. Bugeja, *B.Eng. (Hons.), Ph.D (Melit.), MIEEE*

### Assistant Lecturers:

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

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

### Visiting Teaching Staff:

Ing. Carl Azzopardi, *B.Eng. (Hons.), MIEEE*

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

### Systems Engineer:

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

### Laboratory Officer III:

Mr. Noel Agius

### Administrative Assistant:

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

### 3. Research activities

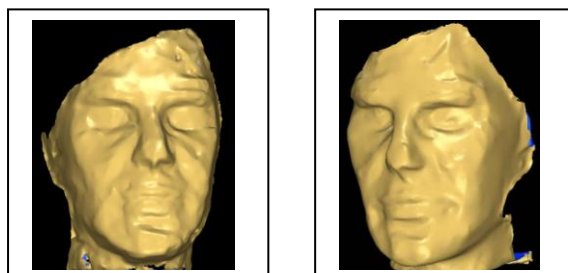
The Department is involved in several research projects, most of which are partly financed through internal and external funding sources. The majority of these projects, which are led by academic staff members, include the participation of postgraduate students whose research contributions lead to the award of Doctoral or Master degrees. The following sections describe the main projects that have been in preparation, ongoing or concluded during academic year 2011/12.

#### 3.1 Low Cost 3D Head Acquisition

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

This research originated as an industry-academia collaborative project funded by a grant from the National RTDI Programme 2004 which concluded in 2010. It involved 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. This work is presently being adapted and applied to the acquisition of 3D data of human limbs.

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) in the Netherlands in July 2011. The project has also been recently presented at the IET 'Present Around the World' (PATW) Competition 2012, a competition open to students and young engineering professionals aged between 18 and 26 years. The first stage of the competition was organized by the Malta Group of Professional Engineering Institutions at the Faculty of Engineering in February 2012. Six participants were chosen to give a 10-minute presentation on their projects, after which a panel of judges deemed the 3D-Head as the winning presentation. Following this, in August 2012, the competition progressed to the Regional Finals in Paris where eight competitors from different countries across Europe, the Middle East, and Africa participated. While the 3D-Head was not awarded the winning prize at regional level, the project received positive feedback from the judging panel and other IET delegates attending the presentations.



Surface maps of a mannequin head

### 3.2 Nonlinear Control, Adaptive Control and Robotics

Main Investigators: Prof. Simon G. Fabri, Dr. Marvin K. Bugeja and Dr. Kenneth Scerri

An extensive series of projects, mainly in the form of undergraduate final year projects under the supervision of the main investigators, focus on the design and application of several modern control methodologies such as nonlinear control, adaptive control and robot control.

These projects, funded through the University's internal research grants, include (but are not limited to):

the implementation of Simultaneous Localization and Mapping (SLAM) algorithms on PowerBot (one of the research mobile robots recently acquired by the department), experimental investigation of self-tuning adaptive control on servomechanisms available in the Control Systems Laboratory, the development and implementation of Fuzzy Control schemes for the laboratory's Pendubot setup, nonlinear control of a ball and plate system, real-time remote control of a Lego Mindstorms robot over the internet, dynamic modelling and control of industrial robotic manipulators, and path planning/control of a team of Khepera mobile robots also available in the Control Systems Laboratory.

In addition, in collaboration with academics from the University of Le Havre in France, research is being pursued on novel visual-tracking techniques for autonomous mobile robots as well as the amalgamation of these techniques with the neuro-adaptive robot control algorithms that were developed in the department in earlier works.



Mobile robot platform



Manipulator modelling and control



### 3.3 Signal Processing Methods for Brain Computer Interfacing

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

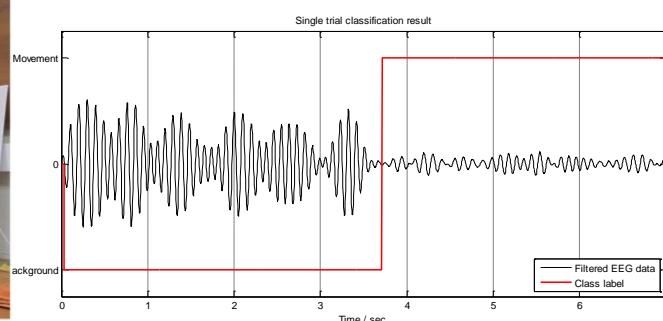
This project is funded by a research grant from the University of Malta and the Malta Government Scholarship Scheme which provided support for one research student. A Brain Computer Interface (BCI) system is a communication system where a person has the ability to communicate with a computer through 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 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 EEG



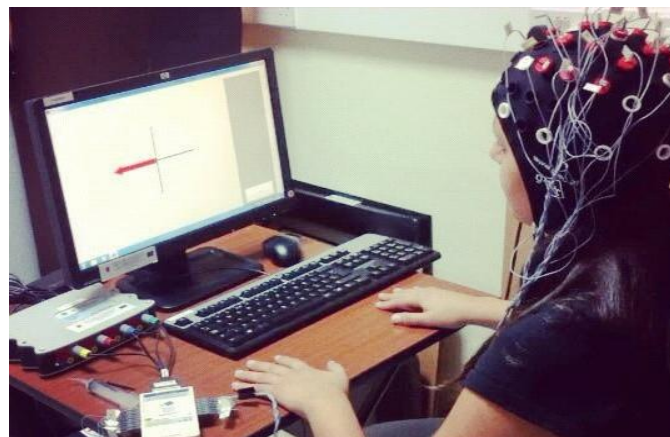
### 3.4 Real-time Brain-Computer Interface Platform

Main investigators: Ms. Tracey Camilleri, Prof. Kenneth P. Camilleri, Mr. Owen Falzon,

This project is funded by a research grant from the University of Malta. Brain-computer interfaces (BCI) provide a means of communication and control dependent only on a user's thoughts and mental activity. Electrical brain signals obtained using electroencephalography (EEG) recording equipment can be processed and converted into commands for control and communication, making such systems particularly useful for locked-in individuals. The goal of this project is to design and build a real-time, modular brain-computer interface platform that can be operated in real-time to test new algorithms and protocols for BCIs. The platform would also allow us to consider the practical aspects of various BCI protocols and interfaces for users in a real living environment.

This project is planned over a period of 3 years. So far a real-time implementation using the g.tec EEG equipment currently available in the biomedical engineering lab has been designed and tested with real subject recordings. Limitations in communicating with a software programme through motor imagery such as left and right hand movements have been identified. These problems will now be addressed, giving more training to the subjects using the system to get better control of their mental activity.

A wireless EMOTIV system for EEG data recording is also being purchased through this grant, allowing us to use more user friendly setups and giving us the possibility of comparing performance with the higher standard EEG equipment currently available. This equipment is planned to be used by undergraduate students with the goal of using other modalities that allow brain-to-computer interface control in real time environments.



The real-time BCI platform in use

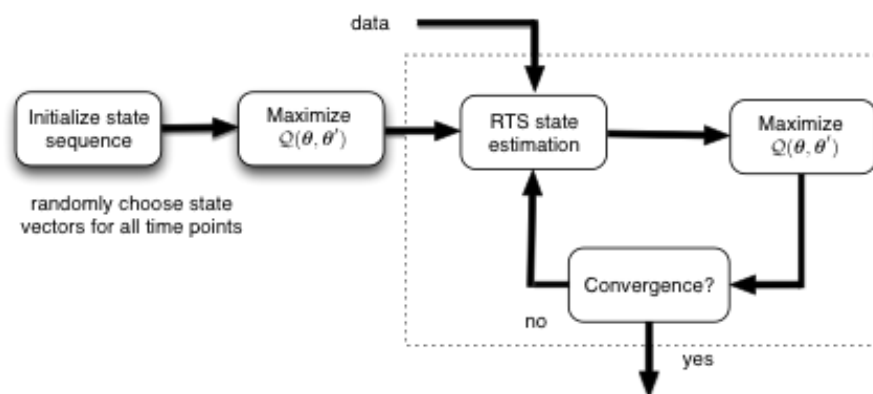
### 3.5 Spatio-temporal Modelling for Systems Biology

Main investigators: Dr. Kenneth Scerri in collaboration with Dr. Parham Arma and Prof. Visakan Kadiramanathan at the Department of Automatic Control and Systems Engineering, University of Sheffield (Sheffield, UK), Dr. Michael Dewar at *bit.ly*<sup>TM</sup> (New York, USA) and Dr. Dean R. Freestone, Department of Electrical and Electronic Engineering, University of Melbourne, (Melbourne, VIC, Australia).

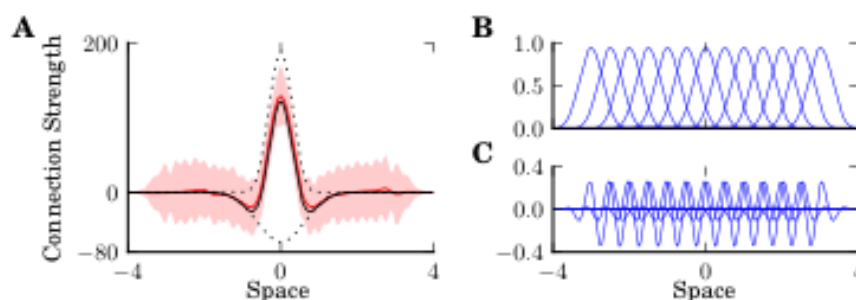
This research, which originated at the Department of Automatic Control and Systems Engineering at the University of Sheffield, has seen the input of staff members from the Department of Systems and Control Engineering. As part of Dr. Scerri's doctoral studies, novel methods based on systems theory for 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. The work during this academic year focused on two additions required for EEG modelling namely:

1. A multi-resolution approximation to the Armani-type neural field network.
2. A convolution based method for the rapid estimation of the neural field connectivity kernel.

Both these addition have lead to journal publications currently under review.



Methodology adopted for joint model and field estimation.

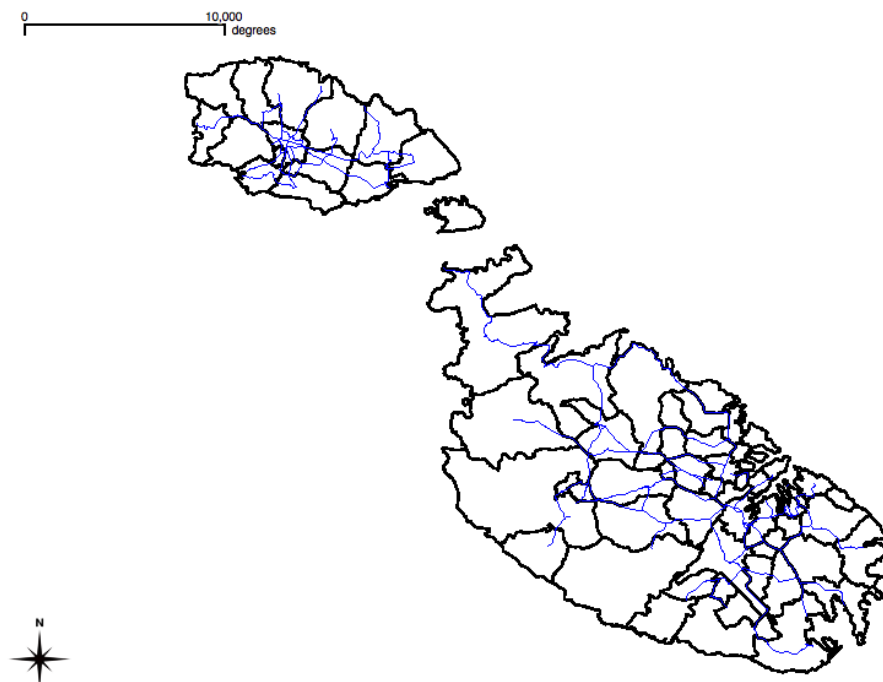


Connectivity kernel together with its confidence intervals and basis functions used.

### 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. Initial work on the data 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. These local sources seem to be mostly attributable to the traffic flow in the vicinity of the measurement sites. Thus the methods developed so far are being extended to account for the contribution of traffic volumes to the pollution measurements. This addition requires the development of traffic models to estimate traffic flow at the pollution measurement sites. These models are being inferred from two data-sets obtained from Transport Malta, namely, a trips survey carried out in 2010 and traffic count data gathered in 2012. The fusion of these two data-sets using Bayesian methods is envisaged to obtain a reliable transport model of the traffic on the Maltese arterial roads and thus an reliable input to the pollution models. On completion, some of this work is to be presented to at least at one peer-reviewed international conference.



Arterial and Distributor Road Network of Malta and Gozo.

### 3.7 Cognitive Vision for Sketch Understanding

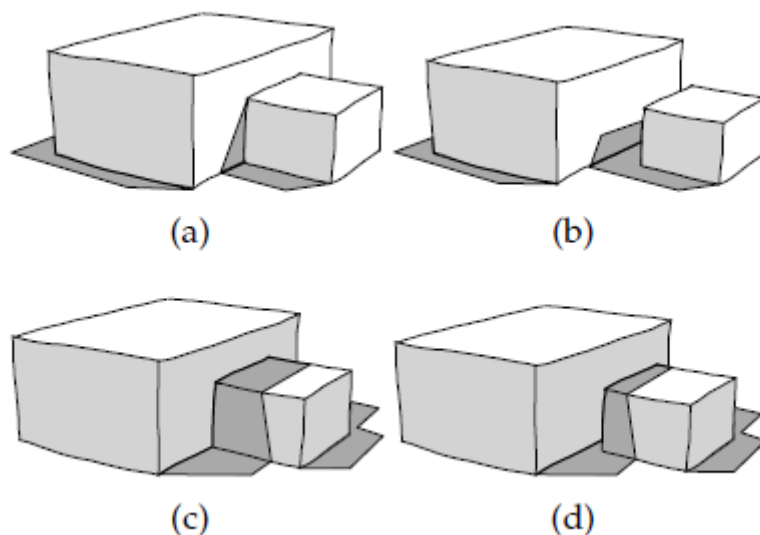
Main investigators: Prof. Kenneth P. Camilleri and Ms. Alexandra Bonnici

While human observers can interpret sketches as 3D objects easily, the same cannot be said for machine vision. This work therefore draws upon our previous experience through collaboration on the “Early Stage Design for Rapid Prototyping” project to develop image processing algorithms that allow sketches to be interpreted as 3D objects.

Line labelling is one step towards this direction, allowing edges to be labelled as concave, convex or occluding, thereby capturing the geometric shape of the object as well as the spatial arrangement of the object within its background. Artists typically introduce cues to help communicate design intent and through this project, we introduce cue-based constraints which determine a subset of labels that can be assigned to an edge in the drawing. Using a genetic algorithm to evolve an initial edge label assignment, we show that these cue constraints can be used to identify the intended interpretation of the sketch as indicated by the sketched cues.

For such a labelling algorithm to be robust and useful to designers, it is necessary to create cue dictionaries that give a complete list of the syntax and semantics of the cues that can be used in the sketch. This should include shadows and shading due to different light source positions since this helps the designer to communicate design intent more effectively.

In addition, we note that cues can have an effect that extends beyond the edges they directly bear upon, so this work investigates the means with which local constraints introduced by the cues can be propagated to neighbouring edges.



Placing light sources in different locations can improve communication of design intent

### 3.8 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. Whereas 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 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 performance of the proposed method is comparable to similar approaches, in view that our solution does not explicitly exploit any temporal information while also allowing the self-guided robot to achieve closer proximity to the obstacles without collisions. Our method for the robot self-guidance was published in the 9<sup>th</sup> International Conference on Informatics in Control, Automation and Robotics, ICINCO 2012, which was held in Rome in July 2012.



## 4. Student Projects and Supervision

### 4.1 B.Eng. students

Project title	Student	Supervisor
Hand Pose Replication using a Robotic Arm	Aquilina Kirsty	Dr. K. Scerri
Anti-sway Control of a Gantry Crane System	Borg Mario	Dr. M. Bugeja
Path Planning and Control of a Mobile Robot Team	Callus Jean Paul	Dr. K. Scerri
Programming of Virtual Haptic Environments	Cassar Matthias	Prof. S. Fabri
Neural Networks for Material Selection	Chircop Diane	Dr. K. Scerri (co-supervisor)
Two-Axis Magnetic Levitation of a Magnetic Material	Debattista Darren	Dr. K. Scerri
Self-tuning PID Controller	Debono David	Dr. M. Bugeja
Simultaneous Localisation and Mapping in Mobile Robotics	Debono Mark	Prof. S. Fabri
Dynamic Modelling of an Industrial Robotic Manipulator	Farrugia Luke	Prof. S. Fabri
Modelling and Analysis of the Interactions Between Air Pollution and Traffic Flow	Formosa Nicolette	Dr. K. Scerri
Remote Control of a Lego Mindstorms Robot Over the Internet	Schembri Darryl	Prof. S. Fabri
Autonomous Control of a Car-like Mobile Robot	Simiana Diandra	Dr. M. Bugeja
Motion Tracking for Artistic Expression in Theatre and Dance	Spiteri Michaela	Ms. A. Bonnici
Fuzzy Control of a Pendubot	Vella Dwayne	Dr. M. Bugeja
Real-time implementation of a motor imagery EEG based BCI	Zerafa Rosanne	Ms. T. Camilleri

## 4.2 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
Implementation of CO <sub>2</sub> sensor for monitoring CO <sub>2</sub> emissions from coal fired Power Plant in Neyveli Lignite Corporation (Tamil Nadu, India)	Muruganand Prabhakaran	Prof. S. Fabri

## 4.3 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
Multiple modelling of EEG data to classify different mental states	Camilleri 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
EEG Signal Phase Analysis for Brain-Computer Interfacing	Falzon Owen	Prof. K. Camilleri
Modelling Spatial Context in Maltese Sign Language Recognition from Video Sequences	Borg Mark	Prof. K. Camilleri, Prof. M. Alexander



## 5. External lecturers and visitors

### From Lund University, Sweden...

Professor Björn Wittenmark from the Department of Automatic Control at Lund University, Sweden visited the Department as External Examiner for the doctoral thesis of Marvin Bugeja which took place in October 2011. Prof. Wittenmark is well known worldwide for his extensive research and publications on adaptive control.

### From the University of Le Havre, France...

In November 2011, 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 presented a mini course on the programming of FPGAs and their application to control engineering. Dr. Lecroq and Mr. Chaigne provided technical support for the installation and networking of PLC equipment in the Control Systems Engineering laboratory. This visit was funded under the EU Socrates-Erasmus programme.

### From California Polytechnic State University, U.S.A...

On the 13<sup>th</sup> and 23<sup>rd</sup> March 2012, the Department invited Dr. Zoe Wood and Dr. Christopher Clark from the California Polytechnic State University to deliver public presentations. Dr. Wood presented a talk entitled *Visualization of Underwater Data* and Dr. Clark presented a talk on *Tracking Sharks with Autonomous Underwater Vehicles*. The two speakers formed part of a team of lecturers and students from the USA exploring and mapping archeological sites in Malta using underwater robots. Dr. Timmy Gambin, from the Aurora Trust and the Department of Classics and Archaeology of the University of Malta, coordinated these explorations. Dr. Gambin also delivered a talk entitled *Remote Sensing at Sea: an end user's tale* on the 20th March 2012. Prof. Simon Fabri and two final year engineering students joined the team for one day during archaeological explorations at Tas-Silg. The team also demonstrated their underwater robots in the campus pool on the 23<sup>rd</sup> March 2012.



With the team during explorations at Tas-Silg



Underwater robot demonstration on campus

### From the University of Malaga, Spain ...

In the summer of 2012, the Department hosted Prof. Dr. Javier Fernandez de Cañete from the Department of Systems Engineering and Automation of the University of Malaga in Spain. Dr. de Cañete spent several weeks in Malta on a collaborative research visit with staff from the Department. On the 19<sup>th</sup> July 2012 he delivered a public presentation entitled *Neural and Genetic Approaches to Modelling and Control of Nonlinear Systems: applications in process engineering*.

### From Brno University of Technology, Czech Republic ...

On the 24<sup>th</sup> September 2012, the department invited Prof. Robert Grepl from the Department of Mechatronics at the Brno University of Technology to deliver a presentation on *Mechatronics Education and Research at the University of Technology in Brno*.

## 6. Teaching activities

The Department is responsible for teaching 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. course on Sustainable Environmental Resource Management that 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 2011/2012

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 1	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
SCE3204	Image Analysis and Computer Vision	5 credits
SCE4101	Computational Intelligence 1	5 credits
SCE4102	Systems Theory	5 credits

## 7. Staff publications (Oct 2011 ~ Sept 2012)

J. Mercieca and S. G. Fabri, "Particle swarm optimization for nonlinear model predictive control", *Proceedings of the Fifth International Conference on Advanced Engineering Computing and Applications in Science - ADVCOMP 2011*, pp. 88-93, Lisbon, Portugal, November 2011.

T.A. Cassar, K.P. Camilleri, S.G. Fabri, "Switching multiple models for the segmentation of sleep EEG data", *Proceedings of the 9<sup>th</sup> IASTED International Conference on Biomedical Engineering BioMED 2012*, Innsbruck, Austria, February 2012.

O. Falzon, K.P. Camilleri, "Phase-synchronization features and common spatial patterns for the classification of motor imagery EEG data", *Proceedings of the 9<sup>th</sup> IASTED International Conference on Biomedical Engineering BioMED 2012*, Innsbruck, Austria, February 2012.

C. De Raffaele, K.P. Camilleri, C.J. Debono, R.A. Farrugia, "Efficient multiview depth representation based on image segmentation", *Proceedings of the 2012 IEEE Picture Coding Symposium, PCS 2012*, Krakow, Poland, May 2012.

A. Bonnici, K.P. Camilleri, "Exploiting artistic cues to obtain line labels for free-hand sketches", *Proceedings of the Eurographics Symposium on Sketch-Based Interfacing and Modeling 2012*, Annecy, France, June 2012.

A. Bonnici, K.P. Camilleri, "Genetic algorithm for line labelling of diagrams having drawing cues", *Proceedings of the 7<sup>th</sup> International Conference on the Theory and Application of Diagrams, DIAGRAMS 2012*, Canterbury, UK, July 2012.

O. Falzon, K.P. Camilleri, J. Muscat "The analytic common spatial patterns method for EEG-based BCI data", *Journal of Neural Engineering*, Volume 9, Number 4, July 2012; <http://iopscience.iop.org/1741-2552/9/4/045009/>.

M. Sapienza, K.P. Camilleri, "A generative traversability model for monocular robot self-guidance", *Proceedings of the 9<sup>th</sup> International Conference on Informatics in Control, Automation and Robotics, ICINCO 2012*, Rome, Italy, July 2012.

C. Azzopardi, M. Azzopardi, R. Muscat, K.P. Camilleri, "Investigating linear superposition of multi-species neurotransmitter voltammetric measurements *in-vitro*", *Proceedings of the 34<sup>th</sup> Annual International Conference of the IEEE Engineering in Medicine & Biology Society, EMBC 2012*, San Diego, USA, August 2012.

O. Falzon, K. Camilleri, J. Muscat, "Complex-Valued Spatial Filters for SSVEP-Based BCIs With Phase Coding," *Biomedical Engineering, IEEE Transactions on*, vol.59, no.9, pp.2486-2495, Sept. 2012

## 8. Staff academic activities

Staff Member	Activities
Ms. A. Bonnici	<p>Reviewer or committee member for international conferences and journals, including:</p> <ul style="list-style-type: none"> <li>- The Eurographics Workshop on Sketch Based Interfaces and Modelling.</li> <li>- Computer and Graphics Journal.</li> </ul>
Dr. Ing. M. K. Bugeja	<p>Member of the Faculty's Board of Studies (Electrical Stream)</p> <p>Member of the Faculty's Board of Accreditation</p> <p>Member of the Faculty's Ad hoc Committee on Assistant Lecturer Loading</p> <p>Coordinator for the Faculty's third year study unit ENR3003 - Team Project</p> <p>Reviewer for journal submissions, including:</p> <ul style="list-style-type: none"> <li>- IEEE Transactions on Systems, Man and Cybernetics (Part B).</li> <li>- International Journal of Systems Science.</li> <li>- Neurocomputing (International Journal by Elsevier)</li> </ul>
Prof K. P. Camilleri	<p>Chairman of the Support Staff Work Resources Committee.</p> <p>Project Leader (Biomedical Engineering Sub-project) of the ERDF Project "Strengthening of the Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities".</p> <p>Director, Centre for Biomedical Cybernetics.</p> <p>Reviewer for journal submissions, including:</p> <ul style="list-style-type: none"> <li>- IEEE Transactions on Image Processing.</li> <li>- IEEE Transactions on Signal Processing.</li> <li>- IEEE Signal Processing Letters.</li> <li>- IEEE Computing in Science and Engineering.</li> </ul>

- IEEE Transactions on Systems, Man and Cybernetics: Part A
- Journal of Electronic Imaging.
- Optical Engineering.
- Expert Systems.
- International Journal of Systems Science

Reviewer or international programme committee member of several international conferences, including:

- The Ninth IASTED International Conference on Biomedical Engineering (BioMED 2012).
- Fifth International Workshop on Intelligent Interfaces for Human-Computer Interfacing (IIHCI-2012).
- Sixth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2012).
- 20<sup>th</sup> European Signal Processing Conference (EUSIPCO 2012)
- 21<sup>st</sup> International Conference on Pattern Recognition (ICPR 2012)
- The Second IASTED International Symposia on Imaging and Signal Processing in Healthcare and Technology (ISPHT 2012)
- The Eighth International Conference on Intelligent Environments (IE 2012)

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

Member on the Editorial Board of the Research Journal of Information Technology.

FP7 Expert Project Proposal Evaluator

Ms. T. Camilleri

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. EEE Board of Studies (Chair), the Academic Work Resources Committee, the Programme Validation Committee, the Research Fund Committee, the Faculty IT Affairs Subcommittee.

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 book publishers, including:

- Wiley.
- Springer.

Reviewer for journal submissions, including:

- IEEE Transactions on Automatic Control.
- International Journal on Advances in Intelligent Systems.

Reviewer or committee member for several international conferences, including:

- The First International Conference on Intelligent Robotics, Automation and Manufacturing.
- International Conference on Advanced Engineering Computing and Applications in Sciences, 2012.
- Twelfth International Conference on Control, Automation, Robotics and Vision.
- International Conference on Informatics in Control, Automation and Robotics, 2012.
- International Conference on Robotics and Automation, ICRA 2012.

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

Dr. K. Scerri

Member of the:

- Faculty Board
- Faculty PR group
- Faculty Doctoral Committee
- Faculty Internal Affairs group
- Faculty Accreditation sub-committee (till February 2012)

Student advisor for international exchange programs.

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

Reviewer for submissions to the IEEE Transactions on Signal Processing.

Review for the Sixth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2012).

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.

## 9. Prizes, awards and appointments

### Doctoral degree:

In November 2011 Marvin Bugeja was awarded the Ph.D. degree from the University of Malta for successfully defending his doctoral thesis entitled “Computational Intelligence Methods for Dynamic Control of Mobile Robots”.

### Promotions:

The Council of the University of Malta promoted Dr. Ing. Mavin K. Bugeja to the grade of Lecturer with effect from October 2011.

The Council of the University of Malta promoted Mr. Noel Agius to the grade of Laboratory Officer III with effect from September 2012.

### Appointment as committee member:

In December 2011, Prof. Simon G. Fabri was appointed as member of the Administrative Council of the newly formed European Control Association.



## **10. Participation in courses, meetings and overseas visits**

### **Research visit at Brno University of Technology, Czech Republic:**

In June 2012 Dr. Ing. Marvin Bugeja visited the Department of Mechatronics at Brno University of Technology, hosted by the head of department Dr. Robert Grepl. Dr. Bugeja delivered two presentations on “Computational Intelligence Methods for Adaptive Control of Complex Systems” and “Dual Adaptive Dynamic Control of Wheeled Mobile Robots” and discussed possibilities of joint research projects and lecturing visits between the two departments.

### **Research visit at Oakland University, U.S.A:**

In August and September 2012, Dr. Kenneth Scerri visited the Department of Electrical and Computer Engineering at the School of Engineering and Computer Science at Oakland University in Michigan, US. Here he participated in joint research on transport modeling and delivered the presentation “Spatio-temporal modeling for Neural Field Modeling”.

### **Attendance at meeting of the General Assembly of the European Control Association:**

In September 2012 Professor Simon G. Fabri attended a meeting of the European Control Association (EUCA) which was held at ETH in Zurich. Prof. Fabri is the Malta representative on the General Assembly of EUCA.

### **PhD Examiner at the University of the Basque Country, Spain:**

In June 2012, Professor Kenneth P. Camilleri was invited to act as examiner for the PhD thesis of Mr Ivan Maćia at the University of the Basque Country, San Sebastian, Spain. The thesis was entitled ‘Medical Image Analysis for the Detection, Extraction and Modelling of Vascular Structures’.

### **Research visits at Kingston University, U.K. and Groningen University, The Netherlands:**

In April and May 2012, Professor Kenneth P. Camilleri was invited to Kingston University, UK and to Groningen University, The Netherlands, respectively, to present some aspects of the Department’s research in image processing and computer vision and to discuss opportunities for collaboration.

## 11. 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 and the Department of Electrical and Electronic Engineering at the University of Melbourne, Australia on Spatio-Temporal Modelling for Systems Biology.

Dr. Ing. Marvin Bugeja and Professor Simon G. Fabri collaborated with Dr. Francois Guerin from the University of Le Havre in France on Vision Based Target Tracking of Wheeled Mobile Robots. Preliminary results from this work are reported in a conference paper submitted for review to the 2013 IEEE International Conference on Robotics and Automation (ICRA 2013) in mid-September 2012.

Dr. Kenneth Scerri collaborated with Prof Fatma Mili from the Department of Computer Science and Engineering at Oakland University, Michigan, USA on transport modelling using Bayesian methods.

### Popular media and outreach activities...

#### Prime Minister's visit:

On the 4<sup>th</sup> October 2012, Prime Minister Dr. Lawrence Gonzi inaugurated the department's Control Systems Engineering and Biomedical Engineering laboratories. These two laboratories together benefited from over €1 million worth of state-of-the-art equipment from the European Regional Development Fund (ERDF) under Cohesion Policy 2007-2013. The event was widely covered in the media, including newspaper articles available at the following links:

[€2m hi-tech labs boost University's research, teaching capabilities](#)

[Two new labs inaugurated at university](#)

[PM inaugurates €2 million investment in new labs](#)

#### Malta Café Scientifique:

Two of the department's staff members delivered public talks as part of the Malta Café Scientifique series held at the Inspirations! Café, St. James Cavalier in Valletta. Professor Kenneth P. Camilleri's talk entitled *You, your brain and your computer* was held on the 10<sup>th</sup> November 2011. The other talk by Professor Simon G. Fabri, entitled *Man vs machine: could robots take over our lives?* took place on the 23<sup>rd</sup> February 2012. Both events attracted a numerous audience.

### European Robotics Week:

The department led the Faculty's participation in the local activities of the European Robotics Week which was held from the 28th November to the 4th December 2011. This European-wide innovative event was coordinated by the European robotics community and supported by the European Robotics Coordination Action (euRobotics) which is funded by the Seventh Framework Programme on Information and Communication Technology. Activities took place simultaneously over sixteen European countries, including Malta, to engage robotics technology stakeholders such as manufacturers, universities and research institutes, to organize outreach activities targeted to students and the general public on the theme of robotics. The objective is to highlight the importance of robotics as an emerging technology in modern application areas, and to use the robotics platform as a vehicle to encourage students in taking up careers and educational programmes in science, technology, engineering and mathematics (STEM). The turnout at the Faculty of Engineering was very encouraging, where a total of about 130 secondary school children visited the robotics set ups and demonstrations over three mornings. These included robot demonstrations in the department's Control Systems Engineering Laboratory and the Industrial Automation Laboratory of the Department of Industrial and Manufacturing Engineering, public lectures, displays from university students who had participated in the 2011 "Robot Wars" competition, two hands-on robot programming workshop sessions, and robotics exhibits from two commercial organizations.



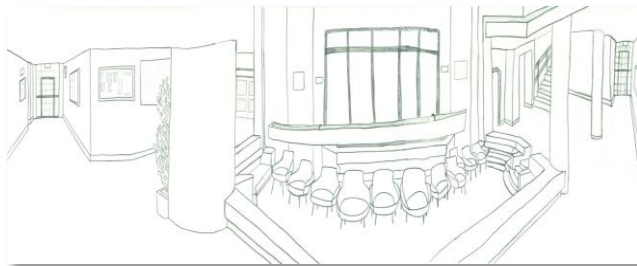
### Press articles, TV and magazines:

Professor Kenneth P. Camilleri, Ms. Tracey Camilleri and Mr. Owen Falzon attended and presented their work concerning the computer-based analysis of brain signals at the Ninth International Conference on Biomedical Engineering which was held in Innsbruck, Austria. This work was elaborated further in a popular [article](#) published in The Sunday Times of the 29<sup>th</sup> April written by Dr. Edward Duca of the Communications & Alumni Relations Office. A longer version of this article also appeared on page 21 of the University of Malta's Think Magazine, [Issue 2](#), Summer 2012.

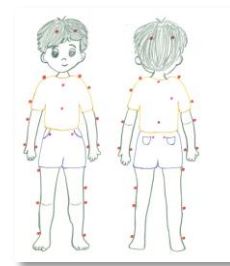
This summer, Professor Simon G. Fabri appeared in a television feature on TVM News explaining the research on robot control taking place in the department, and the recent links with researchers from California Polytechnic State University in the USA who used underwater robots to explore archaeological sites on the Maltese Islands. This work was also featured in an [article](#) written by Dr. Edward Duca which appeared on page 40 of the University of Malta's Think Magazine, Issue 2, Summer 2012.

### UoM Summer School:

The department participated in the Kids on Campus summer school by giving three interactive workshops on the 31st July, 7th and 8th August for children aged between five years and six years. In these workshops, we introduced the concepts of obstacle detection and avoidance through the use of Lego Mindstorms. A further hands-on workshop for ten year old children was held on the 3rd August. During this workshop, children were presented different concepts of systems and control engineering through games. A thermal imager was used to locate hidden thermally different objects from the foyer of the Faculty of Engineering, the Vicon motion system was used to play a game of “Simon Says” using the children’s skeletal model, while Lego Mindstorms robots were programmed by the children to perform object detection and avoidance.



Locating thermally significant objects hidden in the foyer



Placing markers to create skeletal models with the Vicon system

### Orthopaedic surgeons and students:

In collaboration with the Centre for Biomedical Cybernetics, Professor Kenneth P. Camilleri, Ing Carl Azzopardi and Ing Stefania Cristina organized and presented a talk to postgraduate orthopaedic students and orthopaedic surgeons entitled ‘Motion Analysis: Data Acquisition and Processing’ in July 2012. This activity is part of an ongoing effort by the Department and the Centre to create multi-disciplinary links between the technical and medical disciplines.

### Science in the City:

Staff members of the department were invited to participate in the live science TV show held at St. George’s Square in Valletta on the 28<sup>th</sup> September 2012 as part of the *Science in the City 2012* festival. Professor Kenneth P. Camilleri and Owen Falzon talked about their research on Biomedical Engineering. Professor Simon G. Fabri and Dr. Marvin Bugeja talked about their research on Intelligent Robotics and demonstrated their neural network controlled mobile robot – Neurobot - in action.