



# Department of Computer Science and Software Engineering

## 2013 Departmental Postgraduate Conference

August 29-30, 2013  
Lecture Theatre 031, Erskine Building

Principal Sponsor



Also sponsored by:



## Thursday 29<sup>th</sup> August (Erskine room 031)

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### Session 1 – Welcome/Keynote/Honours

*Session Chair: Dr Andreas Willig*

<b>9:00</b>	9:30	Coffee/Tea/Orange Juice and nibbles
<b>9:30</b>	9:45	Welcome: Professor Tanja Mitrovic (HOD), Dr Richard Green (PG Coord)
<b>9:45</b>	10:15	<b>Keynote Speaker: Dr. Ray Hidayat (Telogis)</b> What's it like to work in Telogis Route?
<b>10:15</b>	10:30	Caitlin Duncan: Developing an Interactive Algorithms Tutorial for New Zealand High School Students
<b>10:30</b>	10:45	Tegan Harrison: The Emotiv mind: Investigating the accuracy of the Emotiv EPOC in identifying emotions and its use in an Intelligent Tutoring System
<b>10:45</b>	11:15	<i>MORNING REFRESHMENTS</i>

### Session 2 – Honours

*Session Chair: Dr Walter Guttman*

<b>11:15</b>	11:30	Jared Klopper: Contour-based cane extraction for 2D vine modeling
<b>11:30</b>	11:45	Joshua McCulloch: A robust wire detector for a vine pruning robot
<b>11:45</b>	12:00	Matthew Smith: Applications of Dual Quaternions for Three Dimensional Transformation Representation and Interpolation
<b>12:00</b>	12:15	Robin Watson: Human gesture recognition in a public setting using depth images
<b>12:15</b>	1:15	<i>LUNCH</i>

### Session 3 – Masters

*Session Chair: Dr Dong-Seong Kim*

<b>1:15</b>	1:30	Jessica Emerson: Tags Clouds in Software Visualisation
<b>1:30</b>	1:45	Lei Gao: Fingertip-based 3D Interaction for Handheld Augmented Reality
<b>1:45</b>	2:00	Benjamin Gibson: Teaching Computer Science with Educational Games
<b>2:00</b>	2:15	Samuel Williams: Mobile Augmented Reality Visualisation Toolkit
<b>2:15</b>	2:45	<i>AFTERNOON REFRESHMENTS</i>

### Session 4 – PhD

*Session Chair: Dr Richard Green*

<b>2:45</b>	3:00	Asad Arfeen: The role of Weibull distribution in Internet traffic modeling
<b>3:00</b>	3:15	Huidong Bai: Markerless 3D Gesture Recognition with RGB-Depth Camera
<b>3:15</b>	3:30	Shinichi Yamada: Variable and Model Selection in High Dimensional Problems

## Friday 30<sup>th</sup> August (Erskine room 031)

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### Session 5 – PhD

*Session Chair: Dr Matthias Galster*

<b>9:00</b>	9:30	Coffee/Tea/Orange Juice and nibbles
<b>9:30</b>	10:00	<b>Keynote Speakers: James Dunlop, Jerney Slade (Orion Health)</b> Innovation in an Agile Development Environment
<b>10:00</b>	10:15	Oliver Batchelor: Metric Learning on Video Sequences for Object Recognition
<b>10:15</b>	10:30	Philip Buchanan: Automatic Single-View Character Model Reconstruction
<b>10:30</b>	10:45	Ricardo Marin: Recovering Vine Structure From 2D Images
<b>10:45</b>	11:15	<i>MORNING REFRESHMENTS</i>

### Session 6 – PhD

*Session Chair: Professor Tim Bell*

<b>11:15</b>	11:30	Davide Floriello: An Algebraic-Statistical approach to correspondence problems
<b>11:30</b>	11:45	Jin Hong: Security modeling and analysis: overcoming the scalability problem
<b>11:45</b>	12:00	Musibau Ibrahim: Development of Multifractal and Multi-scale Techniques for Biomedical Image Analysis
<b>12:00</b>	12:15	Joshua Leung: Spatially Stable Overview Widgets for File Browsing
<b>12:15</b>	1:15	<i>LUNCH</i>

### Session 7 – PhD

*Session Chair: Dr Kouros Neshatian*

<b>1:15</b>	1:30	Ehsan Tabatabaei Yazdi: Adaptive Resource Allocation for mobile Body Sensor Networks
<b>1:30</b>	1:45	Amir Moravejsharieh: Cooperative Resource Allocation For Wireless Body Sensor Networks
<b>1:45</b>	2:00	Amir Shareghi Najari: Using examples in Intelligent Tutoring Systems
<b>2:00</b>	2:15	Kapila Pahawalatta: Particle Detection and Classification in Photoelectric Smoke Detectors using Image Histogram Features
<b>2:15</b>	2:45	<i>AFTERNOON REFRESHMENTS</i>

### Session 8 – PhD

*Session Chair: Professor Tanja Mitrovic*

<b>2:45</b>	3:00	Tong-Wook Shinn: Combining the Shortest Paths and the Bottleneck Paths Problems
<b>3:00</b>	3:15	David Thompson: Teaching CS in High School: New Curriculum Challenges
<b>3:15</b>	3:30	James Wen: Are User Preferences of Mobile Pedestrian Navigation Tools Based More Upon Perception or Performance?
<b>3:30</b>	3:45	Thomas Young: Searching for Darwin's Replicator
<b>4:00</b>	5:00	<b>Social gathering/Award Ceremony in the Staff Club</b>

# Abstracts

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## Keynotes

### **Dr. Ray Hidayat from Telogis**

#### **What's it like to work in Telogis Route?**

What's it like to work in the industry with a degree like yours? This talk will cover some of the projects and processes that you might encounter at a place like Telogis.

**Ray Hidayat** graduated with a PhD in Computer Science from the University of Canterbury in 2010. He then signed up as a software engineer at Telogis, starting in a team of 4 people. Since then, he has helped develop the processes necessary to support a growing team (now 15 people) in a growing company (now 120 people in Christchurch), as well as develop the algorithms to optimize routes for thousands of deliveries and constraints.

### **James Dunlop, Jermey Slade from Orion Health**

#### **Innovation in an Agile Development Environment**

Given an Agile Development environment how do we go about innovating? Where does innovation fit in with day-to-day work? What are some different ways we can think about innovation? This talk will cover some ideas around answering these questions and also how we look at innovation at Orion Health.

**James Dunlop** is a Senior Team Leader for Orion Health in Christchurch. James leads a development team to produce world-class software for the Healthcare industry. James's background is in running agile development teams and Test Leadership for varying organisations in New Zealand.

**Jeremy Slade** is a Senior Team Leader for Orion Health in Christchurch. Jeremy leads a development team to produce a world-class Hospital information System. Jeremy's background is in running agile development teams and Business Analysis for varying organisations in New Zealand and the UK.

## Honours

### **Caitlin Duncan: Developing an Interactive Algorithms Tutorial for New Zealand High School Students**

Computer Science was introduced to New Zealand schools as an NCEA topic for the first time in 2011. The rapid development and introduction of these NCEA standards resulted in a lack of teaching resources and has left many teachers feeling unprepared to teach these topics. Providing easily obtainable resources is crucial to the success of this curriculum. We present here research to underpin the development of a resource for students and teachers to assist them with the algorithms section of the curriculum. This will form a chapter in the online textbook, the Computer Science Field Guide (CSFG), and will convey the basic concepts of what an algorithm is, their associated costs and the vast differences in costs for algorithms which accomplish the same tasks. Preliminary results show teacher feedback as positive.

### **Tegan Harrison: The Emotiv mind: Investigating the accuracy of the Emotiv EPOC in identifying emotions and its use in an Intelligent Tutoring System**

Emotion is an important element in computing as emotions influence the decisions we make, how effectively we learn and how we communicate with others. In our study we aim to investigate the accuracy of the Emotiv EPOC in measuring user's emotions and to determine if the device is feasible for use in an intelligent tutoring system. The Emotiv EPOC is a wireless, light weight EEG that tunes into the electrical signals released from the brain to determine the user's thoughts, feelings and expressions. This device was used in two separate studies to determine user's emotions. The first study used the International Affective Picture System (IAPS) to induce emotions and found inconclusive results. We then made improvements on this study and we hope to find a high correlation between the participant's self-report scores and emotional values provided by the EPOC. In the second study we used a "think aloud" technique where participants used EER-Tutor while stating their thoughts aloud. This monologue was then compared to the EPOC emotional values for similarity and the results proved to be more significant.

### **Jared Klopper: Contour-based cane extraction for 2D vine modelling**

Modeling grape-vines from a two-dimensional image has a number of interesting problems which have to be overcome. Due to their growth patterns and the surrounding environment vines tend to grow in ways which result in a large number of occlusions from a single perspective, making identification difficult. In addition the presence of wires, posts and other foreign objects increase complexity. We propose a method which uses the contours extracted from an image to identify canes. An emphasis has been made on identifying only sections of canes which are not occluded. Our method extracts the contours, creates a model of all edges and pairs up edges which contain similar properties such as their width and direction. High quality edges pairs are then selected to produce partial cane models. We have found this technique is able to reliably identify most canes which are not occluded with minimal errors.

### **Joshua McCulloch: A robust wire detector for a vine pruning robot**

Automation is being rapidly applied to tasks performed in the vineyard; most of which can be completed with simply brute force, stripping, spraying, planting, etc. Pruning however poses some significant challenges such as decision making and dexterity and thus currently is only performed by humans. A team at the University of Canterbury is developing an automated vine pruning robot which draws expertise from many fields including computer vision, artificial intelligence and robotics. This robotic systems requires an accurate model of the structure of the vine's canopy in order for decisions about where and how to prune the plant to be made. We present a system to detect wires in the canopy using support vector machines. Our system uses Bayer Images of the canopy, captured by the robot, and processes each pixel to determine the likely hood that it represents a wire. This system uses a small set of effective features that can be used to identify wires with high precision rates. This small set of features was found using a greedy search from a large library of generated features.

### **Matthew Smith: Applications of Dual Quaternions for Three Dimensional Transformation Representation and Interpolation**

Abstract: Quaternions have long been integral to the field of computer graphics, due to their minimal and robust representation of rotations in three dimensional space. Dual quaternions represent a compact method of representing rigid body transformations (that is rotations and translations) with similar interpolation and combination properties. We examine their use for rigid transformations in the context of a skeletal animation system. The bone hierarchy can be constructed with dual quaternions and a sequence of identical hierarchies with different transformations at each bone can be interpolated between to produce animations. Weighted transformations required in skinning the skeleton structure to a triangular mesh also prove an effective application of dual quaternions. We construct such a system, and evaluate it against other rigid transformation methods such as matrices and translation/rotation pairs.

### **Robin Watson: Human gesture recognition in a public setting using depth images**

Computer vision based gesture recognition for interactive public exhibits are subject to constraints where users of the system may occlude one another or may otherwise not be entirely visible to the camera. Depth sensitive cameras record the distance from the camera for each pixel in its image and providing many opportunities in computer vision. Standard human pose recognition techniques for depth images can very quickly determine pose of a number of people. They use machine learning techniques such as decision trees using large data sets and are trained to recognise only the whole human body. This research presents a more mechanical method, using depth data from a depth sensitive camera, to determine pose in users who may be subject to occlusion.

## **Masters**

### **Jessica Emerson: Tags Clouds in Software Visualisation**

Modern software systems are notoriously large-scale and complex, making comprehension difficult. This talk will present a system using tag clouds as a visualisation technique to help users understand and analyse software engineering data. The challenges in evaluating an information visualisation system will be discussed.

### **Lei Gao: Fingertip-based 3D Interaction for Handheld Augmented Reality**

Current handheld Augmented Reality (AR) applications heavily rely on conventional touch-screen based interaction methods for virtual object manipulation. Although this type of interface requires less prior knowledge to study, it cannot provide intuitive 3D interaction experience due to a lack of real-time depth information. To deal with this issue, we developed a 3D fingertip-based interaction method for handheld AR using an attached RGB-Depth camera to provide intuitive 3D interaction experience in 3D space. By identifying fingertips and mapping their 3D positions into the coordinate system of AR virtual scene, our proposed method allows users to perform operations on virtual objects using their fingers in midair with six-degrees-of-freedom (6DOF). We conducted a user study in which we compared the performance to a 2D touch-based interface. We concluded that traditional 2D touch-based interface performed faster than our proposed 3D gesture-based interface. However, our method provided a high entertainment value.

### **Benjamin Gibson: Teaching Computer Science with Educational Games**

Much work has done on teaching Computer Science by having students program games. In comparison, However, little has been done on teaching Computer Science by having the students learn from playing educational games. The current work in this field does not seem to be particularly cohesive. There is no clear idea of what has already been done. The focus of this thesis is provide a clearer picture of the state of the field. The first and primary part of the thesis was to find and provide detailed information on as much of the existing educational games that teach Computer Science as possible. With this information it can be clearly seen that while a few topics, mainly binary and high level programming concepts, have sufficient coverage, most have barely been touched. The secondary

part of the thesis focuses on expansion of the field. This is achieved through providing guidelines on producing new work as well as examples.

### **Samuel Williams: Mobile Augmented Reality Visualisation Toolkit**

It is especially common in mobile augmented reality research to examine results which were attained with unpublished tools and data sets. This makes it difficult to compare and improve on existing work without significant initial investment. This paper discusses the development of an open source framework called Tranform Flow which currently includes includes a data capture application for iOS, and a desktop application to replay and analyse said data with a variety of different algorithms. This project seeks to provide a common platform on which tracking algorithms for mobile augmented reality can be developed and eventually deployed via cross compilation.

## **PhD**

### **Asad Arfeen: The role of Weibull distribution in Internet traffic modelling**

This talk will highlight the important role played by the two parameter Weibull distribution in Internet traffic modeling. Internet traffic structurally consists of sessions, flows and packets; and traverses through different tiers of service providers during its end-to-end journey. Observation of invariant heavy tails in access traffic patterns of individual users has motivated us to investigate traffic transformation/aggregation as it traverses from access to core network. We found that the flexible nature of the Weibull distribution can capture this transformation at inter-arrival level. We also present and justify our hypothesis that given a suitable scale parameter specific to a certain access media or tier, the Weibull shape parameter can be used to zoom in from session to flow and to the packet level inter-arrivals.

### **Huidong Bai: Markerless 3D Gesture Recognition with RGB-Depth Camera**

Natural gesture interfaces offer intuitive manipulation experience for Augmented Reality applications. Most current visual-based techniques use fingertips or palms for 3D interaction to simplify the full hand gesture recognition problem. As a more dedicated solution, state-of-the-art full hand gesture recognition algorithms require powerful hardware and complicated initialization steps while running with low interactive frame rates. Our work-in-progress research presents a novel 3D markerless gesture recognition method using a RGB-Depth camera. Combining 2D contour tracking and 3D skeleton matching, our method is expected to achieve fast and accurate markerless gesture recognition in 3D space, which could be easily utilized for Augmented Reality interaction on mobile devices with limited computation capacity.

### **Oliver Batchelor: Metric Learning on Video Sequences for Object Recognition**

Specific object recognition typically uses Bag of Words and sparse image features. Image features strive to be invariant in many ways, such as rotation and scale, but real world data is often more complex with perspective warping, occlusion and reflection. I explore some ways to use data to learn the required invariance using the temporal coherency between video frames. We aim to make use of some form of distance metric learning, a form of supervised learning, to achieve these goals.

### **Philip Buchanan: Automatic Single-View Character Model Reconstruction**

This presentation showcases our new method for automatically constructing 3D meshes from a single input image. With the increasing content demands of modern digital entertainment and the expectation of involvement from users, automatic artist-free systems are an important step in allowing user generated content and rapid game prototyping. The system uses a novel heuristic to transform a single piece of non-occluding 2D concept art into a rigged 3D low polygon model suitable for use in realtime applications such as video games.

### **Davide Floriello: An Algebraic-Statistical approach to correspondence problems**

In Correspondence Problems we try to match pixels, between two or more different images of the same scene, that represent the same features. It Represents a fundamental step to achieve a 3D reconstruction of the pictured scene through Epipolar Geometry. I propose a new method to solve Correspondence Problem that aims at using only algebraic, geometrical and probabilistic assumptions. In this way, I am able to get rid of some assumptions that are often challenged in real-life applications.

### **Jin Hong: Security modeling and analysis: overcoming the scalability problem**

Security modeling and analysis is widely adopted methodology to evaluate potential danger in networked systems, and there are many different model types and functionalities provided by different modeling techniques. However, previous research showed that evaluating the security of a large sized networked system suffers from a scalability problem due to state space explosion (i.e., capturing all possible states in a given network). To overcome the scalability problem, we used a hierarchical attack representation model (HARM) to model network hosts and host vulnerabilities in two different layers. We have shown the complexity analysis in our previous study, and we have extended our work to show how different network topologies can affect the performance of security analysis via simulations. Further, we proposed logic reduction techniques to improve the scalability of generating tree-based attack representation models, and importance measures to select subset of network components to generate and evaluate using the HARM. In this work, we summarise our findings on improving the scalability of security analysis of large sized networked systems.

### **Musibau Ibrahim: Development of Multifractal and Multi-scale Techniques for Biomedical Image Analysis**

Fractal dimension is a very useful metric for the analysis of structures within images with statistically self-similar properties and finds applications in areas such as texture segmentation, shape classification and analysis in medical images. There are several approaches for calculating the fractal dimension of digital images but the most popular method is the box-counting method. This method overlays a grid of boxes on the object and counts how many boxes intersect with the object. However, previous results have confirmed that this method is not numerically stable and its computational efficiency is not high. Another method of estimating fractal dimension was introduced by applying Higuchi's algorithm on digital images. 2D digital images were converted to 1D signals and the Higuchi dimension of these 1D signals was calculated using Higuchi's algorithm. Validation of this proposed approach was investigated by comparing the estimated fractal dimension of images with the theoretical values. The overall analyses of this technique compared with the box-counting method were examined and the experimental results confirmed that Higuchi's method is more accurate and efficient.

### **Joshua Leung: Spatially Stable Overview Widgets for File Browsing**

Navigating to files is a tedious and time consuming process in the current generation of file browsing interfaces, requiring a lot of clicking and scrolling for each retrieval operation. With file systems steadily growing in size and complexity this poses a significant problem for knowledge workers, whose performance ceiling is current limited by the physical demands imposed on them by traditional interfaces. In this talk, we present a spatially stable overview widgets technique (SCOFT) for improving file browsing performance, and discuss the design and implementation issues that needed to be solved.

### **Ricardo Marin: Recovering Vine Structure From 2D Images**

This research is focused on extracting the hierarchical structure of vine canes from 2D digital images. The hierarchical structure includes the spatial connectivity of all the parts of the vine. The methods for estimating the hierarchical structure must resolve occlusions and overlapping vines. In this conference I will talk about two different approaches to decompose the vine images into cane segments: 1. Using a probabilistic approach, by modeling canes as mixture of Gaussians that can be fitted using the Expectation Maximization algorithm and model selection theory; and 2. Using local orientation and

vector fields to construct a trunk flow that can recover whole cane segments and that could be used for the structure formation in the future.

#### **Amir Moravejshari: Cooperative Resource Allocation For Wireless Body Sensor Networks**

The channel scarcity phenomenon has recently introduced new challenges in the field of Wireless Body Sensor Networks (WBSNs). Within a WBSN, nodes communication is restricted throughout their defined active period. As the number of WBSNs increases, the overlapping active periods are elevated due to inefficient utilization of the spectrum. This consequently results in higher packet loss ratio and eventually performance degradation of the WBSNs entirely. To overcome the aforementioned issue, we have proposed three new scheme called "Initial-Choice", "Greedy Channel Utilization" (GCU) and Idealized schemes. Initial-Choice scheme represents the ability of scanning the whole spectrum before actually starting the pre-configured activities. The shorter the number of active WBSNs in specific operating channel, the higher probability of being selected as the best channel to settle in. While in GCU scheme coordinators compete for slot reservation and attempt to utilize the channel voraciously by pushing other contestants in to sleep mode. We have also proposed Idealized scheme which is an unrealistic scheme and is designed to determine the upper band of what is possible to be achieved in future. To evaluate the performance of our proposed schemes, we compared the proposed schemes with the bare IEEE 802.15.4 Std. terms of channel utilization percentage, packet loss ratio, sensors orphan time and energy consumption of sensors and coordinator.

#### **Amir Shareghi Najari: Using examples in Intelligent Tutoring Systems**

It has been observed that human tutors use a combination of examples and problems when they teach students. Therefore, in our study last year, we investigated the effects of using a mixture of examples and problems compared to examples only and problems only. The result showed that students who worked with alternating examples and problems learnt more than students who worked with examples only or problems only. We used a fixed sequence of alternating examples/problems. Research shows that students, in different stages of learning, need various amount of information. Therefore, in our next study, we are going to test our new model, which provides adaptive sequences of examples and problems.

#### **Kapila Pahawalatta: Particle Detection and Classification in Photoelectric Smoke Detectors using Image Histogram Features**

Due to the failure of detecting smaller smoke particles ( $< 1$  nm in diameter) and the occurrence of false positives by commercially available photoelectric smoke detectors, a new detection algorithm was constructed by analysing the image histogram features of smoke particles generated by Rayleigh scattering light to detect and classify the smoke particles of common household fires. Seven particle types were selected and exposed to a continuous spectrum of light in a closed particle chamber and a significant result was achieved over the common photoelectric smoke detectors by detecting all test particles using colour histograms. As Rayleigh theory suggested, comparing the intensities of scattered light of different wavelengths is the best method to classify different sized particles. Existing histogram comparison methods based on histogram bin values failed to evaluate a relationship between the scattered intensities of individual red, green and blue laser beams with different sized particles due to the uneven particles movements inside the chamber. The proposed classification algorithm which is based on a particle density independent feature, histogram maximum value index, classified all the monotype particles with 100% accuracy. As expected, the classifier failed to distinguish wood smoke from other monotype particles since wood smoke is itself a complex composition of many monotype particles.

#### **Tong-Wook Shinn: Combining the Shortest Paths and the Bottleneck Paths Problems**

We introduce a new problem in graph theory that has relevance in real life applications. The new problem is essentially a combination of the the well known shortest paths problem and the bottleneck paths problem. We call this new problem "Shortest Paths for All Flows" (SP-AF). The SP-AF problem is to find the shortest paths between vertices for varying flow requirements. We present an algorithm that can solve the SP-AF problem from one source vertex to all other vertices in an unweighted digraph in  $O(mn)$  worst case time complexity.

### **David Thompson: Teaching CS in High School: New Curriculum Challenges**

In January 2011, New Zealand saw the introduction of new NCEA curriculum standards for Digital Technologies, including new Achievement Standards in programming and computer science. Two surveys of NZACDITT, a teaching community of practice, have been conducted to gauge their ability to understand, adopt and implement these new standards in the classroom. Insights have been gained about teachers' ability levels, tools, confidence and motivations, and a number of challenges have been identified in terms of resource availability and support for professional development. Extending from a prior focus on measuring virtual learning environments, this research will instrument an online CS field guide (currently under development), in order to better understand how this resource is being used to support high school CS education achievement.

### **James Wen: Are User Preferences of Mobile Pedestrian Navigation Tools Based More Upon Perception or Performance?**

Studies comparing mobile pedestrian navigation aides have generally based conclusions on either survey results from separate trials of exclusive interface usage or on performance of the interfaces as judged by the speed with which users are able to complete wayfinding tasks. However, it is not clear if users would mirror their individual trials or find a more strategic mixed-mode approach to using the tools at their disposal when given an option to choose from a set of tools. It is also unclear if users actually care about performance when choosing a mobile navigation tool. We conducted a study to compare actual usage of navigation tools against user perception of the tools and performance with the tools in a series of wayfinding tasks. Results indicate that independent surveys can align well with extreme cases while performance may not actually be a good indicator of usage preferences.

### **Shinichi Yamada: Variable and Model Selection in High Dimensional Problems**

Kernel methods are successfully applied in many areas of science and becoming the researchers' first choice when classification and function estimation are required in high dimensional space. The key insight which makes it possible to work with a million of variables is that we need to control capacity to keep the expected error rates to be low. The importance of the notion was discovered by Vapnik and Chervonenkis in the 1960s. I would like to do a short talk about the capacity concept from the classical VC dimension to recent regularization theory.

### **Ehsan Tabatabaei Yazdi: Adaptive Resource Allocation for mobile Body Sensor Networks**

One of the main problems faced by wireless networks is the fact that they need to share and use the same medium for communicating. To rectify the interference occurring in this condition, researchers have proposed different ways to address this problem. The main target of this talk is to investigate ways of improving the connectivity and QoS of Wireless Body Sensor Network (WBSN) nodes.

### **Thomas Young: Searching for Darwin's Replicator**

Imagine a rockpool beside an ocean on the ancient earth. Look closely - it's full of simple molecules, dancing around under the heat of the sun. Often they collide, and when they do, they react. New molecules are formed and, given enough time, perhaps something very interesting happens - perhaps they start to evolve. Now imagine how we might duplicate that in a simulation. What molecules would we start with? How do they collide? Imagine now that we're actually not that interested in this particular tidal pool, in this particular way that things started to evolve. How would we go about working out what things are important, and what things are just complicated accidents of history? How could we maximize our chances of discovering something interesting without having to solve the whole origin-of-life problem? Well, we can't claim that we know the answers to these questions either, but we can talk about some of the things we've been trying!

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Telogis has appeared on the Inc. 5000 list of fastest growing private companies for five consecutive years and has been named to the Deloitte Technology Fast 500 for four consecutive years. In 2011 Telogis forged a partnership that made it the exclusive SaaS solution for Ford Motor Company's Crew Chief™ commercial vehicles telematics system.

Telogis is headquartered in Aliso Viejo, Calif., with offices in Europe and Latin America as well as development centers in Austin, Texas; Toronto; and Christchurch. Telogis' products and services are used and distributed in more than 100 countries worldwide.

The R & D team here in Christchurch is growing rapidly and Telogis is always looking for top talent. Offering a fantastic working environment, alongside some of the brightest minds in the industry. If you're interested in finding out more about the limitless opportunities at Telogis, email [nicki.graf@telogis.com](mailto:nicki.graf@telogis.com) or visit [careers.telogis.com](http://careers.telogis.com)

A blue banner with a word cloud of terms related to technology and work. The words include "flexitime", "creative", "challenging", "heuristics", "agile", "great people", "free food", "algorithms", "mapping", "great team", "UX", "simulated annealing", "JavaScript", "C#", and "UI". At the bottom left is the Telogis logo, and at the bottom right is the text "A career that makes you think... careers.telogis.com".

**Telogis** A career that makes you think... [careers.telogis.com](http://careers.telogis.com)



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Trimble products are used in over 141 countries around the world. Employees in more than 30 countries, coupled with a highly capable network of dealers and distribution partners serve and support our customers. For over 33 years, Trimble has created unique positioning products that help customers grow their business. Our portfolio includes over 1,800 patents and serves as the basis for the broadest positioning offerings in the industry. Trimble augments its organic product development with strategic acquisitions to bring the latest positioning technologies to a wider market.

<http://www.trimble.com/>



**Jade** is a leading global product innovator with over 30 years' experience. Every day we move Europe's trains, control the world's ports, manage financial institutions and help solve complex crimes for some of world's most respected police forces. We grew up as a leading edge technology innovator and today some of the world's best known companies trust us with their reputations. They view Jade as a source of their own innovation and ask us to design solutions to realise their greatest opportunities. Our ideas are inspired by a deep understanding of our customers' needs. Jade's design methods, development capability and high performance technology allow us to translate concepts into prototypes and develop solutions for customers quickly. Our collaborative approach and human centred design process is a key tool that sets us apart. We work with partners all over the globe and are quickly adapting an open innovative work environment, to foster the sharing of expertise and encourage creative thinking. We encourage this innovation at Jade every day. Social media activates and staff engagements are helping us achieve this, and create the vibrant company that makes Jade a great place to work. Standing behind the Jade brand are our people. The Jade team has more than 350 members, working throughout North America, Europe, Asia the Middle East and Pacific. It is a recognised market leader in the logistics line of business, with successful implementations of port container management and train rail control systems in every continent. The Ports management system operates extensively in New Zealand and Australia along with Italy, Abu Dhabi and has recently been deployed in Iraq and Norway. In the area of Investigations and Intelligence is the award-winning solution, Investigator. Investigator has been deployed in 29 countries and 6 languages and is used by the world's leading police forces, intelligence agencies and companies for monitoring terrorist activities, protecting witnesses, investigating crime and corruption, protecting borders and keeping the Olympics drug free. Supporting these products is Jade's high performance technology. The latest development is JOOB, a next-generation, .NET data storage solution which was launched to prototype testing last month and will be available In November. The future for Jade is bright and Canterbury offers the perfect base for growth - local Universities with world class graduates, a rich industry support network and worldwide links create the perfect incubation for success. We have the passion, the people and high performance technologies and the emerging mobile and virtual space offers an exciting field to be playing in!

<http://www.jadeworld.com/>



**Dynamic Controls** is the world's leading manufacturer of electronic controls for power wheelchairs and scooters. Focusing on innovation and growth in the bio medical engineering sector, Dynamic Controls works to go above and beyond expectations to ensure end users receive the best product possible in order to enhance their quality of life. Dynamic Controls is unique in that we specialize in the medical mobility market. Products range from cost effective integral controllers to a world leading modular control system that can be customised to suit a wide range of user needs. In addition we have a range of scooter controllers suitable for small, lightweight mini shoppers to rugged outdoor scooters. All our products are renowned for reliability. Dynamic Controls is a global organization which employs 333 people, with corporate headquarters in New Zealand and regional offices in the United Kingdom, North America and Asia.

<http://www.dynamiccontrols.com/>



**Orion Health's** 350 (and expanding) employees supply technology and services to over 1100 clients worldwide.

Orion Health is a leading provider of clinical workflow and integration technology for the healthcare sector. Orion Health's clinical information software meets the information needs of clinical staff and healthcare managers, delivering secure, universal access to healthcare information and helping healthcare providers proactively manage and coordinate patient care across the community. Orion Health's integration and messaging products streamline the exchange of healthcare data within organisations and between business partners. Integrating healthcare systems throughout the world since 1993, Orion Health contributes to integration and clinical workflow projects across the globe for clients including Abbott Laboratories, New York State Department of Health, Capital Health, New South Wales Health, and the New Zealand Ministry of Health. Orion Health has offices in the United States, Canada, United Kingdom, Spain, Dubai, Singapore, Bangkok, France, Australia and New Zealand, and our growing network of partners includes leaders in technology and services such as Oracle Corporation, LogicaCMG, Sierra Systems, Sun Microsystems, Philips Medical Systems, Hewlett-Packard and IBM. Further information including a video featuring staff in our Auckland office can be found at [www.orionhealth.com](http://www.orionhealth.com).



**Tait Communications:** Our clients protect communities, power cities, move citizens, harness resources and save lives all over the world. We work with them to create, support and unify the critical communication solutions they depend on to do their jobs.

Digital mobile radio communication forms the central nervous system of everything we do. Around this resilient, robust core we design, develop, manufacture, test, deploy, support and manage innovative communication environments for organizations that have to put their total trust in the systems and people they work with.

Our global Service Management Centers are staffed with trained and experienced professionals using industry-leading management applications to monitor and manage our client's critical communications networks, allowing them to focus on their core objectives.

We've worked hard to develop genuine insight into our clients' worlds, and have pursued engineering, operational and services excellence for more than 40 years. This understanding, and our belief in championing open-standards technology, means we can give our clients the best possible choice and value to achieve the human outcomes they're driven by.

We're not simply aligned with our clients, we're devoted to their cause.



**PayGlobal Limited** is a privately held company established in 1991 in Christchurch, New Zealand, and employs approximately 90 customer-focused, talented individuals. Our mission is to provide clever technology solutions that help organisations pay and manage their people. PayGlobal has offices in Christchurch, Sydney and Auckland. We have approximately 500 customers. Having worked alongside a diverse range of New Zealand and Australian businesses for more than twenty years, providing comprehensive, proven payroll and human resources solutions that maximise efficiencies and productivity, and deliver an impressive ROI. Having a secure and diverse customer base provides a solid platform for year on year growth by continually responding to new market trends and technology. PayGlobal's employees, based in Australia and New Zealand, are dedicated to delivering market-led intelligent people management solutions.

<http://www.payglobal.com/>



**SLI Systems** makes site search and merchandising easy. We install, customize, integrate, host and maintain everything for site visitors find the products and information they want. Most search technologies use complex algorithms to determine which results should be returned for a query. Our patented Learning Search technology takes relevance a step further by learning from site visitors' behaviour over time to deliver more relevant results. We are a global business with over 50 staff in Christchurch, with additional offices in California, London and Melbourne. The Christchurch office is the anchor tenant for the new Enterprise Precinct and Innovation Campus Project (EPIC).

<http://www.sli-systems.com/>