GRC

Geoinformatics Research Centre

AUT UNIVERSITY

Newsletter Issue 1, March 2009

From the Director

Welcome to this first issue of the Geoinformatics Research Centre's newsletter. We thought it would be good from time-to-time to send out something in this form. This we hope, will serve as a baseline for you to keep up with our developments.

I would like to begin by thanking you all for participating in the work of the GRC. The nature of what we are doing as a central focus for our research requires us to have sensor telemetry instrument sets in numerous locations and with nine sets sending data in real time to our server here in Auckland, we are able to build up a significant and we hope, meaningful array of data that will be informative and useful for researchers and practitioners alike. More on that later in this bulletin.

Beginning in August 2007, the Centre grew from just me with an idea that I would 'retire' as of the end of 2008 from being the Deputy Vice Chancellor at AUT and return to full-time research in Geocomputation, which although my background is in data modelling and software engineering, has been a long-term interest area of mine since I first established a similar research group at the University of Otago in 1987. At AUT I was able to use some existing research funds to employ two research fellows and am delighted we have Dr Subana Shanmuganathan who was a PhD student of mine and just returned from a two year post-doc in Japan and Akbar Ghobakhalou, who was a student in my department at Otago University and is just completing his PhD. Subana's background is in biology and computer science, with her PhD in environmental modelling using contemporary computational techniques. Akbar's background is in electrical engineering and computer science, with his PhD topic being in signal processing.

My interest in the area of micro-climate modelling and its focus on vineyards, came from a sabbatical leave I spent in Chile, which has led to my appointment as a visitor at the Universidad Catolica del Maule (UCM) in the city of Talca. I have an adjunct research professorship in the Faculty of Engineering and am also attached to the University's Innovation Development Group. My relationship also with Universidad de Talca and others in Chile and Uruguay has led to a wider interest in South American education and research, while also forming partnerships with La Agricloa Jackson and Zonamerica in Montevideo, Uruguay and Casa Donoso Winery in the Maule Region of Chile. Our research group has installed instrument sets in both of these locations and also on the Campus of UCM. All are transmitting climate data to our server in Auckland.

From the early days of the Centre we formed a technical relationship with *Cognetive Systems* Inc of Irvine, California. Their work with sensor technology and applications in viticulture and agriculture has helped inform our thinking about telemetry architectures and issues relating to irrigation particularly.

In Japan we have built on a long-term research relationship with scientists at the Ritsumeiken Asia–Pacific University (APU) in Beppu. They have established two sensor telemetry sites in vineyards in Ajimu in the south of Japan. We are now receiving real-time data from these sites and are conducting experiments with soil temp/humidity and leaf wetness sensors to establish correlations with atmospheric data. In the lab here at the GRC we have built an array of sensors and software for data collection and interpretation, which will use the results from the experiments in Japan for calibration purposes. Once we have completed these tests we will install the sensors in our other partner locations, probably starting with La Agricola Jackson in Montevideo.

A new relationship with the Institute of Space and Earth Information Science at the Chinese University of Hong Kong is very exciting. I visited there in December and agreed with the Director and staff to explore a collaboration to share data and hopefully, to ingest some of their climate recordings into our database for comparison purposes. A new winery venture in China has possibilities for us to collaborate with a vineyard too, which is a very exciting prospect.

In New Zealand we have three operational climate sets in vineyards at Mahaurangi River in Northland, Kumeu River near the West Coast of Auckland and Awarua Vineyard in the Hawkes Bay on New Zealand's North East Coast. All are transmitting regular atmospheric data to our server.

So we have an active and energetic group of researchers and industry partners. Thank you all again for working with us!

We have been able to publish our results internationally and now have 13 publications in the scientific domain with another three in progress. A summary of each publication is in this newsletter for your information but all are available in full and downloadable from our website at www.geo-informatics.org.

We are applying for research grants to fund our research but so far have been unsuccessful. Fund acquisition is extremely difficult but we are trying all possible sources.

Not to be daunted, our group moves on and is enjoying the work we are doing. In addition to Subana and Akbar, Kitty Ko has joined the GRC as Centre Administrator and Research Officer. Kitty has a background in Information Systems and until recently was a lecturer in the School of Computing and Mathematical Sciences at AUT. Kitty also has a degree in accounting and an MBA and is a Chartered Accountant. All this combined with her happy personality is adding greatly to the running of the Centre. Over the summer we have had two student interns, Robbie Young and Sara Zandi. Robbie has been working on our website released today with this Newsletter. I'm sure you'll agree he has done a good job and we are looking forward to your feedback as we seek to develop and improve the quality of information we can provide through it. Sara has built what we call 'The Matrix', which is a large and complex SQL database to ingest the real-time data from our sites. She has also written the programs for asking questions of the database and you will see how this works for you when you go to the website. Together, Robbie and Sara have added much to our work and we are very grateful for the time, expertise, energy and professionalism they have contributed to the GRC.

In 2009 we have five PhD students beginning with the Centre. John Gajardo from University of Talca is working in the area of hyperspectral analysis using contemporary remote sensing techniques and has already done considerable work in the modelling of potential waterway pollution from forest fires. It is a very poignant

topic given the recent fires and loss of life with huge environmental damage in Australia. Mary Carmen Jarur Munoz from UCM has been working with me on frost prediction algorithms for viticulture applications. She intends to pursue this topic within the context of a PhD programme. Isaac Kwadwo Nti from University of Ghana will be researching the Modelling simulation and visualisation of the physical landscapes evolution and Waife Owusu-Banahene also from University of Ghana, will be researching techniques for visualising environmental influence factors in viticulture as his PhD topic. Peter Sumich from AUT who has a background in Information Systems, Technology Transfer and Financial Systems will be investigating the dynamics of econometric modelling for technology impact in vineyards and the wine industry generally. This is an exciting group of PhD students and each will be reporting their work as the year moves on.

I will be spending time in Japan, Chile and Uruguay again this year and of course, will be operating out of the lab here at AUT. I am delighted that we have got off to such a good start with people and the science, especially with our publications. The small amount of funding we have has bought equipment and enabled some conference attendance but we need more to continue developing. I am very grateful to Professor Ajit Narayanan who heads up the School of Computing and Mathematical Sciences at AUT for his support in this regard and for the research cluster funding he has allocated to the GRC for 2009. I am also grateful to the Faculty of Design and Creative Technologies at AUT for the support we have with locating the laboratory and associated infrastructure. In particular I am grateful to Vice Chancellor Derek McCormack who although he says reluctantly 'let me go' from my Deputy Vice Chancellor role, has enabled me to return to research after 10 years in senior university administration. In addition to my work in the GRC he has retained me in a Pro Vice Chancellor's role to provide some leadership for Innovation and Enterprise at AUT.

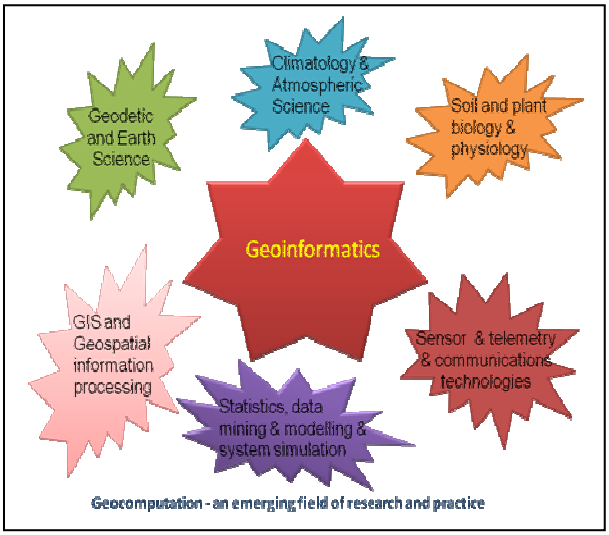
This Newsletter is intended to be somewhat informal, although informative. I hope you find it so and we would welcome any contribution you wish to make for the upcoming editions of it. Please send them along to us for inclusion.

With every best wish,

Philip Sallis
Director

What is Geoinformatics?

The field of Geoinformatics combines several academic disciplines and relates to research and practice that uses geo-spatial data. The diagram on the next page illustrates the blend of geographical, geological, computing, engineering, mathematics and statistics influences on this combinatorial field of endeavour. The term 'Geocomputation' has become popular in recent years to move beyond 'Geoinformatics' to include social and economic influences in the mix of contributing disciplines but yet retaining the computational core or hub that is intrinsic to the methods used that gather and analyse data from numerous sources and combine them in complex dependency models. Identifying factor dependencies that influence for example, grape growing and production and also wine quality, is a central programme of research within the GRC as can be seen in the description of our current projects in this Newsletter.



Current Projects

The work of the GRC includes research, teaching (a new Masters course in Geoinformatics and Geocomputation is being offered at AUT from 2010), supervision of Masters and PhD students, instrument testing and measurement, and sensor technology development. The range of projects currently underway in the GRC is listed below, which includes some doctoral research. The *Eno-Humanas* Project, which is a broad programme of research covering several sub-projects, is also described in concept below.

GRC Projects

Eco-Humanas

- Vineyard micro-climate studies
- Plant, soil, climate and atmosphere correlations
- Frost prediction and irrigation management using computational neural network methods
- Wine characteristics by location using contemporary data depiction and visualisation methods
- Audio mining / speech processing and discourse analysis of wine taster commentaries
- Sensor telemetry configurations and signal processing/ data logging methods
- Image processing methods for plant and fruit condition analysis
- Real time, wireless and communications architectures
- Remote control and robotic solutions
- Data mining, modelling and database design methods for mixed type geospatial data
- An "electronic nose" for grape and vine quality discrimination

Other Projects

- Hyperspectral analysis for waterway pollution modelling of forest fire outcomes
- Modelling and simulation of physical landscapes evolution
- Visualisation of environmental influence factors in viticulture
- Viticultural econometric models for geospatial technology impact analysis

The Eno-Humanas Project

Concept: To provide scientifically based information for use by grape growers and wine producers in their ongoing endeavour to improve crop production, product quality and yield through the synthesis of environmental and human sensory perception data.

The research relates to grape growing and wine production. This research is intended to be a long-term project observing climate, atmosphere, plant and soil data in vineyards, combined with data concerning wine quality gathered and analysed using a both expert and casual opinions. The methods used in the research are contemporary mathematical and software engineering methods and include novel techniques for how to select the 'rough data', how best to classify and model 'fuzzy data' and how best to synthesise precise or exact

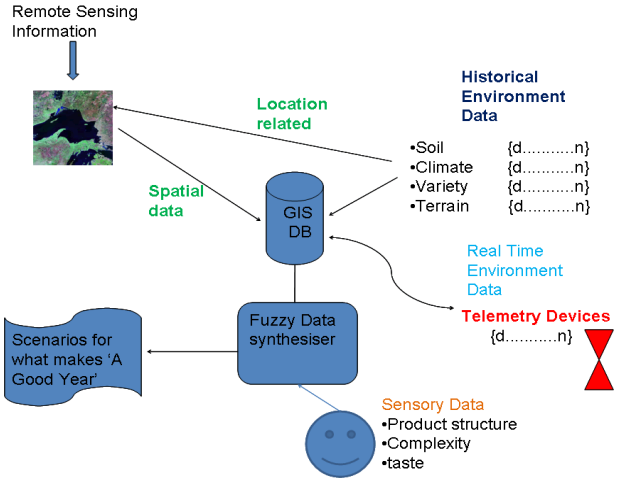
(quantitative) data, such as that from climatic and environmental attributes with other imprecise or inexact (qualitative) values. These qualitative values can be considered as fuzzy data which includes human sensory responses that form personal opinions based on smell, taste and other associated variables that form a spectrum of qualitative values. In the domain of wine tasting, these sensory variables are generally referred to as the 'structure' and 'complexity' of the finished product.

Arising from the proposition that wine is regularly regarded as being of better quality in some production years than others, the mathematics and software engineering methods mentioned above are combined in this research with data processing techniques from the fields of spatial information processing, environmental and bio-ecological modelling, to develop a system that integrates all available data and synthesises them to produce scenarios that can be used to modify growing and production methods in order to achieve the best possible wine in any given year.

Land-Satellite imagery will be used to provide a sequence of terrain maps showing changing weather patterns over time. Superimposed on these will be environmental data collected in real time from sample locations in Chile, the USA and New Zealand to illustrate the atmospheric variability of the individual regions, which will provide a visual comparison in addition to the numeric correlations resulting from analysis of the data collected by telemetry devices feeding in real time to the GIS database, which can be interrogated for numerous cross-correlation purposes.

In some cases the data received will be in fuzzy form. Using contemporary neural network modelling software, these results will be collated and depicted in such a manner that scenarios for considering the 'best year' proposition can be appreciated and in conjunction with other factors, lead to the modification and optimisation of both growing and production methods. These neural networks will be analysed statistically to extract knowledge as to which variables have most effect on desired outcomes.

The following figure illustrates the principal components, their interactions and data flow through the concept intended for prototype implementation.



Our industry partners include:

- Mahurangi River Winery, Northland, NZ
- Kumeu River Winery, Henderson, NZ
- Awarua Vineyard, Hawkes Bay, NZ
- Casa Donoso Winery, Valle de Maule, Chile
- Santa Elisa Vineyard, Parral, Chile
- La Agricola Jackson Montevideo, Uruguay
- Ajimu Winery, Beppu, Japan
- Ajimu Estate, Beppu, Japan

We also have instrument sets contributing data to the grid from the San Miguel Campus of Universidad Catolica del Maule (UCM), Chile and through our technology partner in Southern California, from Fallbrook Wineries situated somewhat South and Inland from city of Irvine.

The scientists involved directly with the research are based at AUT in New Zealand, UCM in Chile and APU in Japan.

News and Events

Geocomputation in the Masters Degree in Computer Science

A new set of courses for the University's Masters Degree in Computer Science will include Geocomputation. This course will be offered by Professor Philip Sallis and others from the Geoinformatics Research Centre. The course will examine the foundation sciences that contribute to Geocomputation and cover earth and land measurement, climate and atmospheric measurement, plant and soil measurement methods. Geodetic Science, Biology, Climatology and Atmospheric Science will be blended with topics from Computer and Information Science such as data mining, data modelling and database design as they relate to Geospatial problems and applications using Geographic Information Systems technologies. Statistical and other information processing methods will be studied and applied through example data sets relating to Geospatial application areas. Remote sensing, hyperspectral analysis and related techniques will be examined as will sensor telemetry systems and communication architectures, with their attendant signal processing and electronic component concepts.

It is assumed that entrants to this course will have come from an undergraduate background in Computer Science or related field such as Electrical or Computer Engineering but the multi-discipline nature of Geocomputation means that applicants from other disciplinary backgrounds will also be considered. If students are not enrolled in the full Masters Degree, it is possible for them to undertake the course and qualify for a Certificate of Proficiency in Geocomputation only.

Visits and Visitors

In addition to Philip's travel to work in Chile and more recently in Uruguay, interchange visits between our scientific partners take place on a regular basis. These are of course, supplemented by GRC staff travelling to present papers at international conferences, which have so far included events in Malaysia, Spain, Greece, USA, and Australia.

Leopoldo Pavesi, a Professor of Engineering from UCM visited the GRC in March 2008. His visit began a series of exchanges concerning his previous work measuring sap rise in grape vines and citrus trees. The prototype equipment he built in Chile is now being refined for utilisation by the GRC in the Eno-Humanas Project.

Philip's visit to Ritsumeikna Asia Pacific Univeristy (APU), 28 Nov - 3 Dec 2008

Philip visited Ritsumeikna APU in Beppu, Oita in Southern Japan on the island of Kyushu. During this visit he meet with APU academic staff, the wine making community of Oita Prefecture and visited vineyards, wineries and chose sites to install weather monitoring stations in two vineyards. Philip gave a seminar to APU staff on AUT, the Geoinformatics Research Centre and the Eno-Humanas project. This collaboration between the two universities, led by Professor Monte Cassim, President of APU and AUT's GRC gives an opportunity to expand our sensor network into the northern hemisphere and opens up possibilities for new collaborative research…and hopefully, funding.

Philip also visited the Chinese University of Hong Kong in December 2008 and presented a research seminar in the Institute of Earth and Atmosphere Science. This potential research collaboration is exciting and has the potential to include wine growers in China for the Eno-Humanas Project.

Howard Jelinck from Cognetive Systems Incorporated in Irvine, California visits NZ from time-to-time for his project work here with 'intelligent irrigation systems'. As a technology partner for GRC, Howard works with us and his team in the USA to investigate new sensor technologies and signal processing methods for agricultural applications.

Bill Claster visit to AUT

Associate Professor Bill Claster of APU will visit AUT between 19-26 Feb 2009 before Philip's second visit to APU, and facilitates further the collaboration between the teams in our two universities. Bill, Philip and Subana have published together in the past and are presently working on a journal paper in the area of data clustering methods.

Mary Carmen Jarur visit to AUT

Professor Mary Carmen Jarur Munoz from UCM in Chile is expected to spend time in September 2009 with staff from the School of Computing and Mathematical Sciences staff at AUT to discuss matters pertaining to an online master's programme being planned for delivery in Chile in 2010. This is in addition to her work with the GRC on the use of computational Neural Networks for use with frost prediction algorithms she is developing with Philip.

Kitty Ko

Kitty joined us as a part-time staff in January. She is the administrator of the Centre and will be involved in the projects of the Centre.

Robbie Young and Sara Zandi

Graduate students Robbie and Sara joined the centre over the 2008-2009 Summer as student interns to gain experience in data logging, transmission via remote wireless sensors and the Internet. Robbie came to us from the University of Canterbury and Sara from Massey University. We have benefitted greatly from their work in the GRC and we wish them well with their continuing studies.

Dr Jacque Whalley

Jacque is a senior research lecturer from the School of Computing and Mathematical Sciences, AUT. Her research interests include Geoinformatics, Computer Graphics, Image and Sound Processing and Information Visualization. She will conduct and be involved in the projects of the Centre.

Conferences attended in 2008

Last year, Geoinformatics Research Centre staff attended and presented papers at the following conferences:

1) 15th International Conference on Neural Information Processing of the Asia-Pacific Neural Network Assembly (ICONIP 2008), Auckland, New Zealand, 25-28, 2008.

2) 12th WSEAS International Conference on CIRCUITS (part of the 12th WSEAS CSCC Multi conference) held in Heraklion, Crete Island, Greece, July 22-24, 2008

3) The 2008 International Symposium on Collaborative Technologies and Systems (CTS 2008), Irvine, California, May 19-23, 2008

4) The Second Asia International Conference on Modelling & Simulation. Kuala Lumpur, Malaysia 13-15 May 2008

Recent Publications

The brief description of some of the recent publications for the period 2007-2008 is listed below. The full paper and the full list of the publications are downloadable from our website at www.geo-informatics.org.

Frost Prediction Characteristics and Classification using Computational Neural Networks

Sallis, P., Jarur, M., and Trujillo, M.

Published in Australian Journal of Intelligent Information Processing Systems (AJIIPS) volume 10.1, 2008 (ISSN 1321-2133) pp50-58.

Abstract. The effect of frost on the successful growth and quality of crops is well understood by growers as leading potentially to total harvest failure. Studying the frost phenomenon, especially in order to predict its occurrence has been the focus of numerous research projects and investigations. Frost prone areas are of particular concern. Grape growing for wine production is a specific area of viticulture and agricultural research. This paper describes the problem, outlines a wider project that is gathering climate and atmospheric data, together with soil, and plant data in order to determine the inter-dependencies of variable values that both inform enhanced crop management practices and where possible, predict optimal growing conditions. The application of some novel data mining techniques together with the use of computational neural networks as a means to modeling and then predicting frost is the focus of the investigation described here as part of the wider project.

Modelling climate change effects on wine quality based on expert opinions expressed in free-text format: the WEBSOM approach

Shanmugathan, S., and Sallis P.

Published in the proceedings of - 15th International Conference on Neural Information Processing of the Asia-Pacific Neural Network Assembly (ICONIP 2008) & Australian Journal of Intelligent Information Processing Systems (AJIIPS).

Abstract. This paper relates to the second aspect of a wider research project called Eno-Humanas, (see www.geo-informatics.org), and looks at the WEBSOM approach to analysing Master Wine Sommelier descriptions of wine quality in free-text format. The main objective of the winder project is to build models for analysing the correlations between dependent variables on climate, atmosphere, soil, terrain, moisture and plant responses along with sensory perception data relating to flavour, odour and fruit robustness to study the climate change effects on wine quality.

Sensor data acquisition for climate change modelling

Shanmuganathan, S., Ghobakhlou A. & Sallis P.

Published in WSEAS Circuits & Systems, Issue 11, Volume 7, Nov. 2008. ISSN: 1109-2734 pp 942-952

Abstract. This paper describes recent advances in sensor technology and wireless radio frequency (telemetry architecture) with the capability for measuring changes in weather and atmospheric conditions that permit modellers to analyse the climate change, its variability and effects on viticulture across the world's major wine producing regions. When combined with GPS (global positioning system) functionality enabling geo-referenced information to be gathered and analysed in real-time, new opportunities emerge for the development of wireless sensor networks (WSN) for decision making in precision agriculture (PA). The use of WSN technologies in precision viticulture (PV) to date is mostly confined to on-farm and narrow regions within a city or in the case of a larger region the data collection is limited to monitoring weather conditions alone. This paper reviews three application scenarios: a) within a vineyard b) regionally within the state of Washington in the USA and c) cities within the Asia Pacific Region. It then details the development of a system proposed for comparative analysis of viticulture management information from two countries, namely Chile and New Zealand that have the same latitude but are at different longitude points. The paper looks at a variety of remotely located real-time sensors (telemetry devices), associated hardware devices (server, workstation, architectures and topologies) and software suitable for data collection, logging, distribution and streaming.

Data gathered by the sensors is relayed via a series of repeaters to a workstation, which logs the data and is connected directly to the Internet for transmission to a server acting as the final collection and data analysis point for a comparative information matching synthesis. The data collected is to be used for building models that could enhance our understanding about the effects of climate change on grapevine growth and wine quality within major wine regions in the two countries being studied in this initial research. Finally, the paper describes variable parameters considered for analysis in this research so far in relation to plant growth, weather, climate, atmospheric influences such as climate change, pollution and also wine quality determinants such as soil, terrain and grape variety.

Kohonen Self-organising maps in the mining data mining of wine taster comments

Sallis, P.J., Shanmuganathan, S., Pavesi, L., and Jarur, M.

Published in 1743-3517 Transactions on information and Communication Technologies, Vol. WIT press. 40 pp 125-139.

Abstract. Computational neural network methods are increasingly being used for research-oriented data mining tasks. Kohonen self-organising map (SOM) techniques are well established within the so-called connectionist paradigm of Artificial Intelligence where neural networks are used to extract both explicit and implicit dependency values between often data that is sometimes disparate in type and kind. The research described here seeks to elicit relationships between grape varieties and their growing conditions using SOM techniques. In addition, utilising k-means and principle component analysis (PCA) methods, the data mined and depicted by the SOM technique is shown to have dependency values that enable a clustering of terms relating to variety quality to be associated with growing condition data to produce optimal locations for each. This study is part of a larger research project that uses comparative data from New Zealand and Chile. The text mining aspect of it forms one element of a 'toolbox' of integrated hardware and software instruments being developed to underpin an environmental modelling methodology oriented not only towards grape growing but also generally for optimal crop production. The example described here uses data from New Zealand in the first instance. The paper begins with a summary of some historical wisdom relating to grape growing with a discussion of some previous studies and then describes the text mining of comments from wine tasters, which are statistically analysed. The results are clustered and the paper concludes with a reflection on the investigation with a pointer to future work in this aspect of the larger research project previously described.

A system architecture for collaborative environmental modelling research

Sallis, P.J., Shanmuganathan, S., Pavesi, L., & Jarur, M.

Published in the 2008 International Symposium on Collaborative Technologies and Systems (CTS 2008), Eds., Waleed W. Samari and William McQuay, A publication of the IEEE, May 19-23 2008 pp 39-47.

Abstract. This relates to early stage research that aims to build an integrated toolbox of instruments that can be used for environmental modeling tasks. The application area described is grape growing and wine production. A comparative study including data gathered in both New Zealand and Chile is described. Using both passive and sensor technology data is gathered from atmosphere, vines, and soil. Human sensory perceptions relating to wine taste and quality is also gathered. The project proposes a synthesizer which collects and analyzes data in real time. Computational neural network modeling methods and geographic

information systems are used for result depiction. This convergence of computational techniques and information processing methods is proposed as being an example of software and systems collaboration. The project called Eno-Humanas is so named because of the bled of the precise enological data and less qualitative human perception data. It is expected that the discrete input elements of the architecture here will be demonstrably dependency-related and derived from correlation values once data gathering instruments and analytical software have been developed. At this stage of the project, these tools and methods are being built and tested. This is the first stage of the project and the proposed research that will come from it in order to answer wide questions such as the ordinal set of data values necessarily present to predict climate conditions, the relationship between vine sap rise and dew point calibrations, towards addressing the popular question of 'what makes for a good year for wine'. In addition to the bringing together of various technologies, methods and kinds of data, (geo-referential, climatic, atmospheric, terrain, plant biological and qualitative sensory expressions), the paper also describes an international research collaboration and its parameters.

Computational intelligence and geo-informatics in viticulture

Shanmuganathan, S., Sallis, P, Pavesi, L. & Jarur, M.

Published in the proceedings of the Second Asia International Conference on Modelling & Simulation. CD version published by IEEE computer society. Eds., Edited by David Al-Dabass, Steve Turner, Gary Tan and Ajith Abraham Kuala Lumpur, Malaysia 13-15 May 2008, pp 480-485.

Abstract. Geo-informatics is a field of science that combines geodetic and spatial information processing methods with computing hardware and software technologies. Research being conducted by the authors extends this blend of science and technology by utilising contemporary computational techniques for data analysis and some sensor and telemetry technologies integrated with spatial information processing methods. The geospatial technologies of Geographic Information Systems (GIS), and Global Positioning Systems (GPS) have had a transformational effect on both the science and industry of this field, as has the advent of wireless telemetry devices. The introduction of what has become known as 'computational intelligence' has added a new dimension to the approaches taken for analysing geo-coded data and furthermore, to the kind of predictions that can be made from it. One domain of application for geoinformatics is in viticulture and enology in which the demand for scientific analysis of the industry due to globalisation has led to widespread research. Thus, the influence of the technologies used in this field have been significant, the changes can be seen across the whole wine industry from grape growing to wine production. The early entry of computing into viticulture and indeed to geo-referenced data analysis began with rule based expert systems (ES), but increasingly, there is a demand for greater precision in the information outcomes from geo-spatial data analysis, especially in agriculture, horticulture and viticulture. The authors are integrating previous scientific methods with state-of-the-art computational technologies to record, transfer and analyse data using artificial neural networks and fuzzy logic. This paper reviews developments in geodetic and computer science over the past two decades and briefly describes the work currently being undertaken by the authors in this field.

A blended text mining method for authorship authentication analysis

Sallis, P. and Shanmuganathan, S.

Published in in proceedings of the Second Asia International Conference on Modelling & Simulation. CD version published by IEEE

computer society. Eds., Edited by David Al-Dabass, Steve Turner, Gary Tan and Ajith Abraham Kuala Lumpur, Malaysia 13-15 May 2008, pp 451-456.

Abstract. The paper elaborates upon the interim results achieved in resolving a few newly discovered 16th century letters now alleged to be written by Queen Mary of Scots (QMS). Despite the significant progress seen in stylometry and its role in authorship attribute analysis especially in disputed writings/ texts controversies over the authorship of Shakespeare's literary work still continue as does research into this corpus of letters. Using more sophisticated computational and mathematical modelling techniques than in previously published research, this study still employs the use of stylometic measures, to show a distinct variation between the authentic writings of QMS and the newly discovered letters, claimed by numerous enthusiasts to be of her authorship. Incorporating additional advanced statistical methods, such as principle component analysis (PCA) and artificial neural networks (ANNs), especially Kohonen's self-organising map (SOM) based visualisation technique, a text mining approach for this application has been developed. The similarities between different pairs of the new and authentic letters and in some cases within individual letters become apparent when using "cusum" analysis adding further complexity to the task of resolving the anomaly seen among QMS loyalists, archaeologists, linguists and the like. The reasons for the inconclusive results of this study are presented with suggestions for future work but in essence, the data mining method used is regarded as being unique in its blend of conventional and non-conventional statistics and useful for this class of text analysis problem.

Statistical Methods in Ecological Dynamics Modelling

Shanmuganathan, S., Sallis, P. J., & Claster, W.

Published in In Oxley, L. and Kulasiri, D. (eds) MODSIM 2007 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2007, pp. 2967-2973. ISBN : 978-0-9758400-4-7.

Abstract. Using stochastic models of discrete-time data and continuous-time series graphs of average values (e.g., annual or monthly) modellers are able to analyse many natural systems and phenomena. These models provide decision and policymaking management with information on the system and/or phenomenon being studied. Nonetheless, since the middle of last century modelling needs have changed significantly. The focus is towards analysing the ecological dynamics of natural habitats during extreme events (i.e. heavy flooding) that could no longer be modelled using discrete time data on normal conditions or average values. For example, information relating to the extent of the detrimental effects on a coastal habitat biota due to infrastructure failures resulting from storm water overflows, the causal factors (i.e., local and/or global) or on how these factors influence the system, is required to resolve resource and infrastructure management and land development issues.

In the case of Long Bay Okura-Marine Reserve in northern New Zealand, ecological data available is inconsistent (in different formats) and this makes ecological dynamics modelling of the coastal habitat extremely difficult. The state institutions, such as Auckland Regional and North Shore City Councils, monitor beach water quality with many sampling locations along the northern coast of Auckland. Academic institutions as well carry out ad-hoc monitoring programmes in the Reserve (established in 1995) for scientifically validating the anecdotal evidence on the effects of urbanisation along this coastal habitat. However, collectively analysing these data sets to model the ecological dynamics of this complex coastal system remains a difficult task. The city council efforts to study the effects of urbanisation along the beach with

conventional methods show the need for better tools and data at frequent intervals on extreme conditions i.e., heavy rains.

Previous research into ecological dynamics modelling using Kohonen's self-organising map (SOM) techniques as applied to the monitoring and control of highly complex and diverse systems in industrial engineering, and their limitations are explained. Finally, the paper explores some simple and complex statistical methods for resolving the issues encountered in ecological dynamics modelling of a coastal habitat using SOM techniques and discrete-time data from the Okura-Marine Reserve.

Our full-time Staff

We are in addition to our partners from science, engineering and industry in NZ and elsewhere:

Professor Philip Sallis
Director of GRC

Philip has held senior academic positions in the UK, Australia and NZ universities. He was the Deputy Vice Chancellor for Auckland University of Technology for 10 year until Dec 2008. His research interests and publications are in Software Engineering (data modelling, metrics, forensics and system performance analysis), Geo-Spatial model building (especially mixed data type modelling and simulations) and Computational Linguistics (especially authorship authentication and thematic analysis).

Dr Subana Shanmuganathan
Research Fellow

Subana's area of expertise is in environmental modelling using contemporary computational methods based on neural network technology. Her current work is predominantly in data mining and data depiction using contemporary statistical clustering and visualisation techniques. She has published a book, several journal articles and presented refereed papers at leading international conferences.

Akbar Ghobakhlou
Research Fellow

Akber's early qualification is in Electrical Engineering. He received his BSc (Hons) in Information Science from the University of Otago. His PhD thesis is on the topic of "connectionist-based adaptive speech recognition systems". He has been involved in a number of research projects ranging from robotic navigation to multimodal biometric person verification systems from which he has published numerous articles and registered a patent. His current research interest includes signal, and image processing, evolving connectionist systems, audio and text mining.

Kitty Ko
Research Officer and Centre Administrator

Kitty's background is in Accounting and Information Systems. She joined the Centre this January and will oversee the administration of the Centre. Her areas of interest include visualisation and data modelling.

Contact Us

We welcome any items of interest, comments and suggestions from you.

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