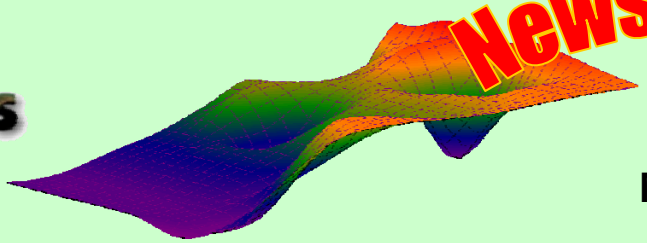
Spatial Data Analysis Network Newsletter



May 2009

SPAN's mission is to achieve excellence in the application of innovative spatial analysis in support of research, education and community outreach

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SPAN is a research support unit within the Centre for Research and Graduate Training at Charles Sturt University. It has offices at Wagga Wagga and Thurgoona campuses to provide postgraduate and staff research support in three main areas: remote sensing, Geographic Information Systems (GIS) and spatial statistics.

Manager's Message

What a busy start to 2009 we have had. It is hard to believe it is May already. SPAN has been involved in some large projects so far this year and this edition gives an overview of some of these. An innovative method of displaying data is shown and there is information about some of the new equipment that is now available for researchers to use.

As well as assisting with various research projects, SPAN has been working with the Division of Facilities Management and other key stakeholders to create a complete GIS representation of the university campuses. The aim of this project is to use GIS technology to produce new clearer campus maps, to keep these up to date more easily and to aid in locating and managing university infrastructure. This project has commenced with Wagga campus and will continue with each of the other campuses as it progresses. Eventually it is hoped that all the maps will be available in an interactive form across the internet, enabling visitors to easily locate their destination, to determine the best route to get there and to print their own customised maps in either colour or black and white. This is quite a challenge but I am confident that SPAN staff have the expertise to accomplish the task.

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Can SPAN help you?

SPAN might be able to assist your research in ways you do not anticipate. From simple data retrieval and map making to complex spatial and statistical data analysis, SPAN is available to enhance the quality of your research. If you are a researcher, academic or postgraduate student at Charles Sturt University and believe that some aspect of your research might be assisted by using our skills, do not hesitate to contact the Manager, Gail Fuller, on 32004 or gfuller@csu.edu.au to discuss your project requirements.

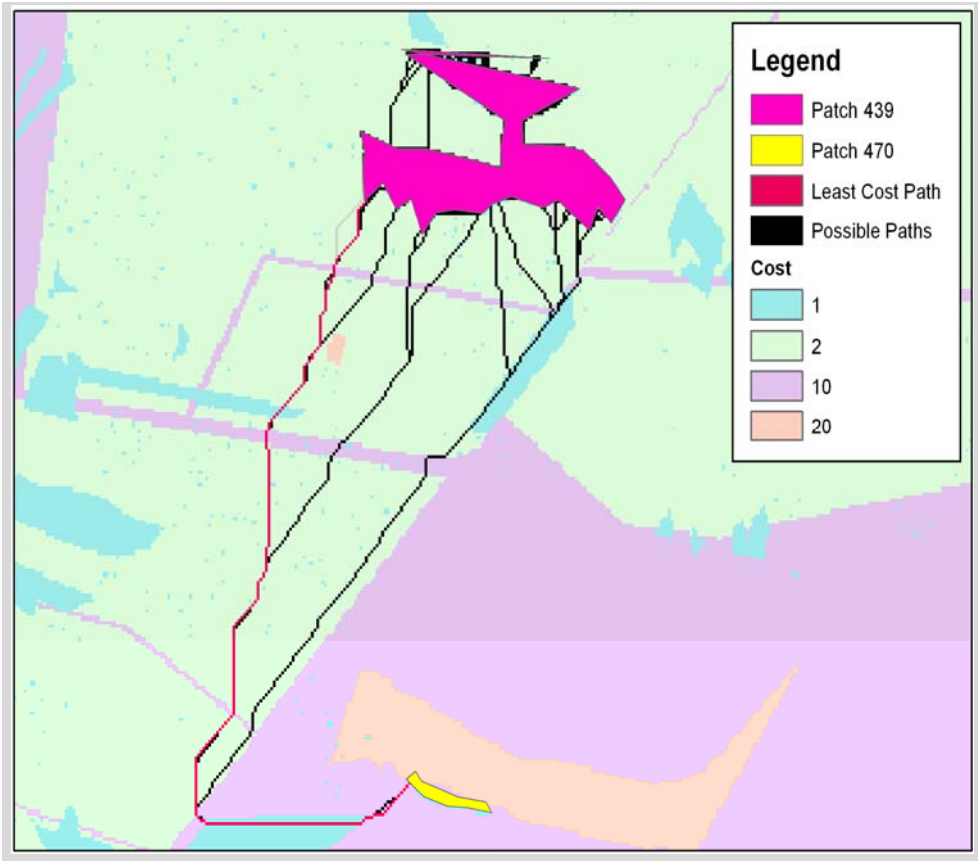
Want to know more? Visit www.csu.edu.au/research/span/

Projects

David Perovic, a PhD candidate based at Orange campus, has been studying the migration of arthropods (mainly insects, spiders and mites) in cotton growing areas. He approached SPAN to see whether least cost-paths could be calculated between 737 habitat patches in order to assess the connectivity/fragmentation of Australian cotton landscapes.

The cost (to the arthropod) of travelling through each different type of landscape was defined by David and used in the least cost-path analysis. Every individual patch had to be paired with every other patch in the landscape, involving 542,432 pairs of patches. Fortunately, least cost-path one way equals least cost-path in the reverse direction so only 271,216 combinations needed to be used in the calculations. Furthermore, the cost distance from a patch to itself is of course 0, resulting in a total of 262,450 individual calculations to be completed.

Even after some carefully considered data preparation, the process required two menu choices in a GIS for each calculation, which would have taken a very long time! SPAN prepared geoprocessing scripts to automate the process, however software limitations proved to be a final hurdle as the GIS package had a tendency to crash at around 3000 geoprocessing commands. So a script in S-Plus (statistics package) was written to convert the GIS geoprocessing commands into 175 python geoprocessing scripts that were then batch scripted in DOS. SPAN had four computers running 24 hours a day for four days to complete the task. The result of the least cost path analysis for one pair of habitat patches is shown below.



Equipment

SPAN's new UNIX computer, 'Tesla', arrived late last year and has now been up and running for some months. Specifications for this machine include two quad core 3GHz processors, 32Gb RAM, 8 x 1Tb hard disc drives and it runs under a Red Hat Linux operating system. Upgrades to the RAID storage array have increased its capacity to approximately 16Tb and the imminent purchase of a larger capacity tape autoloader will ensure that all data will be backed up.

Remember that SPAN has technical equipment available for researchers to borrow, such as:

- Hand held GPS units;
- 'Nomad' rugged PDAs with inbuilt GPS;
- Ricoh 8Mp digital cameras with inbuilt GPS;
- 'Toughbook' field portable laptop;
- Spectroradiometers – 400-1100Nm and 300-2500Nm units;
- MADIS multispectral airborne digital imaging system.

Printing:

SPAN also prints photo quality conference posters and banners up to 1m wide and many metres long. High quality full colour A4 printing is also available, suitable for thesis printing. All SPAN's printing is done at very reasonable rates for CSU staff and students and can be charged by internal funds transfer.

Projects

In 2005, Raf Freire of SAVS and colleagues discovered that domestic chickens use the earth's magnetic field as a means of orienting themselves. Just like migratory birds, chickens appear to use special pigments in the eye for sensing the Earth's magnetic field. Chickens, however, have magnetite in their beak, as do pigeons, raising the question of what function this magnetite serves. One possibility is that birds such as pigeons and chickens use the magnetite in their beak to detect differences in the **strength** of the magnetic field, rather than using it as source of directional information.

In conjunction with Dany Kuriakose, a visiting PhD student from Frankfurt, a test was designed to determine whether chickens could learn to locate hidden food using the presence of a magnetic field as the only indicator of the food's whereabouts. Chickens were trained to locate food near a strong magnetic field, and then tested in a square arena. An electro-magnetic coil was hidden underneath one of the corners of this arena to generate a strong magnetic field. An overhead video camera recorded the birds' movements while in the arena, and SPAN has developed a protocol for automatically recording the position of the birds and where they search for food.

The automation process begins with extracting still images from the video footage, a sample frame of which is shown below (Fig 1). The arena in which the chickens moved around was defined by being more "textured" than the remainder of the box. The selected area was then divided up into a 4x4 array of 'regions'. The chickens and parts of the textured region were found by an image processing technique known as thresholding (Fig 2). Based upon size and shape, the chickens were then automatically distinguished from the threshold image. A count was recorded in the corresponding region based upon the centroid of the chickens. If the hypothesis is correct, one would expect the region covering the buried coil to record more counts of chickens being present than the other regions.

With 648 five minute video segments of 7500 frames each, there is over 600 Gb of image data to analyse however this has saved at least 54 hours of watching the video footage and manually recording the chickens' movements. Analysis is still ongoing but the initial indications are that the protocol works reliably and should significantly improve the accuracy and efficiency of this behavioural testing paradigm.

Fig 1: Still image from video of two chickens in the arena

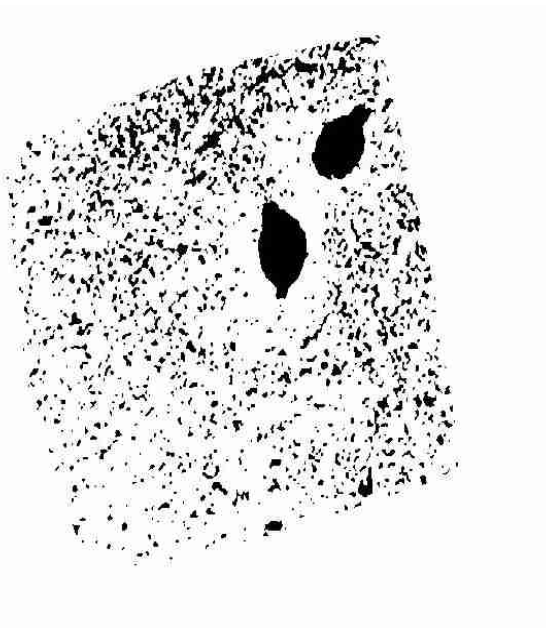
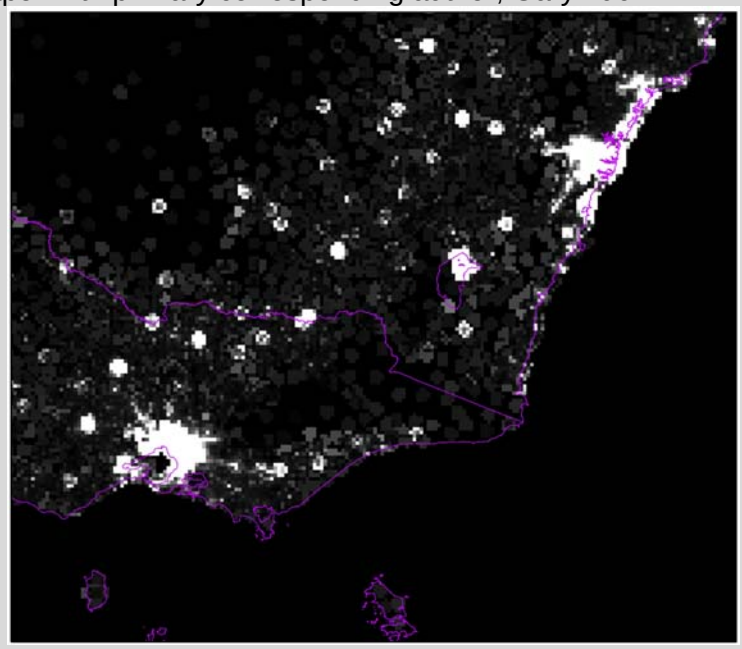


Fig 2: Threshold processing of video still image

Projects

Recently SPAN used Python, S-Plus and Matlab scripting to calculate Human Population Density based on the Australian Bureau of Statistics' 2006 Census data using the algorithm known as Surpop V2.0 by Martin & Tate 1997 (http://cdu.mimas.ac.uk/surpop/background.html). The algorithm is designed to emulate population patterns rather than assuming homogeneity across a particular spatial unit, such as census district or local government area. This technique was explored as part of a paper with primary corresponding author, Gary Luck.



Displaying Data

Presenting complex multi-dimensional data in an interesting and easy to understand format is often a difficult task.

Over a number of years Vianne Tourle and Peter O'Meara used questionnaires to survey first, second and third year students in the paramedic course. Questions relating to their gender, home location and their desired employer once their studies were completed were asked, along with their reasons for these decisions. This generated quite an amount of interesting data for which SPAN provided statistical assistance. The next challenge was to create a graphic that illustrated these three elements.

The figure shown below is the result. This technique is known as 'parallel sets' and it is useful for visualising categorical data. This particular chart was constructed in ArcGIS and S-Plus was used for the statistics.