



## INNOVUS

## DISCLOSURE FORM

The purpose of this form is to disclose information on a new business idea or innovation to the University. This will enable the University to support the initiative of the party concerned and to ensure that all possible intellectual property rights (including expertise) are sufficiently protected on behalf of both the individual and the University. Such disclosure of information by the individual concerned and support by the University will enable the individual and the University to commercially exploit such ideas in partnership and to protect the rights of the entrepreneur(s).

**1. Name of the innovation**

Radiometric [colour] correction of aerial imagery by calibration with satellite images

**2. Background to the innovation**

2.1 Which known technology (prior art) related to the innovation already exists?

Colour-balancing of aerial imagery: Involves applying a series of algorithms to reduce inconsistencies in colour between images.

Image fusion (pan-sharpening): the use of a (usually higher resolution) panchromatic image to increase the spatial resolution of a (usually lower resolution) multispectral image.

Atmospheric correction of satellite imagery: the use of (usually lower resolution) satellite imagery relating to atmospheric conditions (e.g. water vapour) to correct atmospheric influences on (usually higher resolution) satellite imagery.

Methods of correcting aerial imagery for atmospheric and bidirectional reflectance distribution function (BRDF) effects that require explicit modelling and inversion of these effects and can also require spectral measurements to in the field or placement of targets of known reflectance.

2.2 Of which publications or patents concerning the known technology are you aware? Please attach.  
None.

### 3. The innovation

| Type of innovation (please tick box)       |                                     |              |
|--|-------------------------------------|--------------|
| Invention                                  | <input checked="" type="checkbox"/> | Multi-media  |
| Business idea                              | <input type="checkbox"/>            | Written work |
| Plant breeders' rights                     | <input type="checkbox"/>            | Procedural   |
| Intellectual property in research contract | <input type="checkbox"/>            | Registration |
| Software                                   | <input type="checkbox"/>            | Diagnostic   |
| Therapeutic                                | <input type="checkbox"/>            | New species  |

Please indicate in which category your technology falls (✓):

| AGRICULTURE                |                                     |                                  |
|----------------------------|-------------------------------------|----------------------------------|
| Agronomy                   | <input type="checkbox"/>            | Diagnostics                      |
| Aquaculture                | <input type="checkbox"/>            | Health Biotechnology             |
| Integrated Pest Management | <input type="checkbox"/>            | Medical Devices                  |
| Food Science               | <input type="checkbox"/>            | Services                         |
| Wine Biotechnology         | <input type="checkbox"/>            | Therapeutics and Pharmaceuticals |
| ENGINEERING                |                                     |                                  |
| Electrical Engineering     | <input checked="" type="checkbox"/> | Chemistry and Polymer Science    |
| Marine Engineering         | <input type="checkbox"/>            | Nanotechnology                   |
| Mechanical Engineering     | <input type="checkbox"/>            | Software and Models              |
| Process Engineering        | <input type="checkbox"/>            |                                  |
| PHYSICAL SCIENCES          |                                     |                                  |
| Biochemistry               | <input type="checkbox"/>            | Biofuels                         |
| Cultivars                  | <input type="checkbox"/>            | Power Generation                 |
| Industrial Biotechnology   | <input type="checkbox"/>            | Renewable Energy                 |
| Plant Biotechnology        | <input type="checkbox"/>            | Solar Energy                     |
| Plant Biotechnology        | <input type="checkbox"/>            | Wave Energy                      |
|                            | <input type="checkbox"/>            | Wind Energy                      |

Shortly describe the innovation here, but attach a complete description with as much detail as possible, sketches etc., including equipment used, procedures followed and results obtained.

The innovation makes use of (usually lower resolution) wide swath width (i.e. wide extent) satellite imagery to correct radiometric inconsistencies (see explanation in next section) in (usually higher resolution) narrow swath width aerial and unmanned aerial vehicle images. The procedure is explained in attached manuscript, but in very basic terms it fits a model that relates the digital numbers of pixels within an aerial image to those of a satellite image acquired at more or less the same time as the aerial imagery. The satellite image should have similar spectral bands to the aerial image. The model is fitted inside a small region (sliding window) for each pixel location in the satellite image, so that local (spatially varying) inconsistencies can be corrected. Once fitted, the model is inverted and applied to the aerial image at its original spatial resolution. This effectively changes the digital numbers of the aerial images to more closely match those of the satellite image. By applying the procedure to each band in a multi-spectral image, a type of "colour matching" is performed.

Which problems associated with the existing technology does this innovation solve?

An aerial survey campaign normally involves the acquisition of a series of images taken from an aerial platform (e.g. aeroplane, helicopter or unmanned aerial vehicle). The images are often acquired over several hours (even days), during which the illumination (e.g. angle of the sun) and atmospheric conditions (e.g. weather) can vary dramatically. This results in radiometrically inconsistent images i.e. images with inconsistent colour tones, uneven grey etc. Inconsistencies can occur between and within individual images. When the aerial images are mosaicked, the result appears unnatural and is difficult to interpret. It also makes the imagery unsuitable for quantitative remote sensing applications.

Which other benefits does the innovation offer?

Apart from the advantage of removing the radiometric inconsistencies in aerial images, if the reference satellite image has been radiometrically corrected (i.e. represents surface reflectance values), the resulting aerial images will also represent (modelled) surface reflectance values. This effectively means that the aerial images can be used for quantitative analyses (e.g. image classification) similar to expensive very high resolution satellite imagery (e.g. WorldView-3).

There is no requirement for time-consuming and costly field measurements of surface reflectance or for the placement of calibration targets of known reflectance that are sometimes necessary for other radiometric correction methods.

Images processed with the described method can be combined to produce a seamless mosaic (i.e. one in which there are no visible discontinuities between adjacent images) without the need for further processing.

Where and when did the idea originate?

The idea occurred to Inventor 1 during an honours student's research project in 2011, in which an radiometrically corrected satellite image (MODIS) was used to quantitative assess the outputs of various radiometric correction techniques (e.g. FLASH, ATCOR) applied on SPOT5 imagery. It occurred to Inventor 1 that, instead of using MODIS imagery for assessing radiometric correction techniques, the actual image can be used for calibration purposes.

Has the idea been disclosed either in writing (whether by email or publication) or verbally and, if so, where and to whom?

The idea was verbally disclosed to Inventor 2 (PhD student), who have now implemented (and improved) the idea programatically. Inventor 2 did present the idea to a small group of staff and students of the Department of Geography & Environmental studies (during a progress report session), but not in any detail.

The idea was also presented in brief overview at the Thicket Forum 2013 (again not in any detail).

When will the invention first be disclosed to the public? Whether through publication; sale or use.

A manuscript (attached) is ready for submission to a scientific journal. It will be submitted as soon as the patent application has been filed.

Do you have a working prototype of the product and are test results available?

Yes, see attached manuscript.

Can the technology be demonstrated?

Yes, see attached manuscript.

What is the development status of this technology? What further industrialisation is necessary to produce a commercial end-product?

Software to automate the procedure has been developed, but it is not ready for commercialization (requires more testing and addition of a robust user-interface).

Who will typically be the clients who will acquire this technology?

Software companies such as ESRI ([www.esri.com](http://www.esri.com)), PCI Geomatics ([www.pcigeomatics.com](http://www.pcigeomatics.com)), Trimble ([www.trimble.com](http://www.trimble.com)), Hexacon Geospatial ([www.hexacongeospatial.com](http://www.hexacongeospatial.com)).

Providers of aerial imagery such as Google Maps, Microsoft Bing, Chief Directorate: National Geo-spatial Information (NGI).

#### 4. Third parties

Is this innovation the result of a research contract? If so, please provide more information.

No.

Who financed the research?

Inventor 2 received funding from the Gamtoos Irrigation Board during the time the work relating to the invention was done.

Inventor 2 recently received a bursary from NRF, but the work relating to this invention was done prior to receiving the grant.

#### 5. Inventor(s) and non-inventors(s) (personal and employment details)

**IMPORTANT:** Please provide us with your complete and latest personal and employment details. This is required in order to process your disclosure and to process the reports and distribution of income that might occur. Please keep us informed of any changes in address and contact details, particularly should you no longer be an employee of SU.

**PLEASE NOTE:** By signing this form, you undertake to give your full co-operation in the commercialisation of this idea/invention.


| 1. Inventor / non-inventor:  |   |
|--|---|
| Full name of inventor<br>(as displayed on ID or Passport)  | Adriaan van Niekerk                             |
| Full name of non-inventor<br>(as displayed on ID or Passport)  |   |
| <b>Definition of inventor:</b><br>Any and all persons who made an inventive contribution to the invention that is the subject of the patent application. For the sake of clarity, only those aspects of the described subject matter that are both new and inventive in light of the prior art, and as such qualify for patent protection, qualify as inventive contributions. |   |
| <b>Definition of non-inventor:</b><br>Any and all persons, other than those that fall within the definition of "inventor", who made a substantial contribution to the project and who, by agreement between the parties, will share in the benefits derived from it.   |   |
| Contact particulars:   |   |
| Telephone number   | 0829205133                                      |
| Fax number   | 0218083109                                      |
| Email address  | avn@sun.ac.za                                   |
| Physical home address  | 41 Belladonna Street, Welgevonden, Stellenbosch |

|   |  |
|---|--|
| % Contribution distribution                                   | 50   |
| Disclosure date   | 6 June 2016  |
| Signature   |  |
| <b>Employment details:</b>                                    |  |
| Position at SU  | Associate Professor                                |
| Faculty   | Arts and Social Science                            |
| Department  | Geography & Environmental Studies                  |
| SU number   | 11425938   |
| <b>2. Inventor / non-inventor:</b>                            |  |
| Full name of inventor<br>(as displayed on ID or Passport)     | Dugal Jeremy Harris                                |
| Full name of non-inventor<br>(as displayed on ID or Passport) |  |
| <b>Contact details:</b>                                       |  |
| Telephone number  | +27 82 843 9679                                    |
| Fax number  |  |
| Email address   | dugalh@gmail.com                                   |
| Physical home address   | 3 Cedar Lodge, 79 Main Road, Muizenberg, Cape Town |
| % Contribution distribution                                   | 50   |
| Disclosure date   | 6 June 2016  |
| Signature   | Dugal Harris                                       |
| <b>Employment details:</b>                                    |  |
| Position at SU  | PhD student  |
| Faculty   | Arts and Social Science                            |
| Department  | Geography & Environmental Studies                  |
| SU number   | 17447585   |
| <b>3. Inventor / non-inventor:</b>                            |  |
| Full name of inventor<br>(as displayed on ID or Passport)     |  |
| Full name of non-inventor<br>(as displayed on ID or Passport) |  |
| <b>Contact details:</b>                                       |  |
| Telephone number  |  |
| Fax number  |  |
| Email address   |  |
| Physical home address   |  |

The following sections must be signed by your Departmental Head and Dean. This is necessary to process your disclosure.

**6. Completed by the Departmental Head**

"I recommend that this business idea or innovation be exploited commercially."

|                          |   |         |
|--------------------------|---|---------|
| Name:<br>Derek Donaldson |  | 14/6/16 |
| Chairperson: Department  | Signature   | Date    |

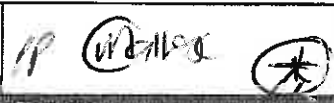
**7. Completed by the Dean**

"I recommend that this business idea or innovation be exploited commercially."

|                         |  |           |
|-------------------------|--|-----------|
| Name:<br>Prof AJ Leyser |  | 21.6.2016 |
| Dean                    | Signature  | Date      |

**8. Completed by the Senior Director: Research and Innovation**

"I acknowledge receipt of this disclosure and from a research management perspective I have no objection to its possible commercial exploitation"

|  |  |           |
|--|--|-----------|
| Name:<br>Dr Therina Theron               |  | 29/6/2016 |
| Senior Director: Research and Innovation | Signature  | Date      |

Please return the signed disclosure form to:

Doris Peters  
Stellenbosch University  
Innovus Technology Transfer (Pty) Ltd  
15 De Beer Street  
Stellenbosch  
7600  
Tel: 021 808 3910  
Email: [dpeters@sun.ac.za](mailto:dpeters@sun.ac.za)

(\*) Sien asb eposse aangeheg  
aan epos van Daniel Jacobs en  
ander Innovus kollegies op 29/6/2016.  
Indien die student (Littander 2) wel  
die beurs sonder ons mededele van  
(betreft)

die Camtias Frigates Board aanvaar het,  
dan is hier IP-implikasies wat uitgeroep  
moet word deur Innovus. ANO en  
Kontak  
Soo 2865. Innovus het in 2012 vir Abnash van  
Niekerk aangedui dat die beurs kontak  
met Camtias teenstrydig is met IPR wet.  
en ne geteken kan word nie.  
(\*) 29/6/2016

