## AARGnews

## The newsletter of the Aerial Archaeology Research Group Offprint from:

## Number 53 September 2016

Contents	
Editorial	4
AARG Chair Piece: September 2016 by Rachel Opitz	7
Student/young researchers' scholarships for AARG 2016	9
AARG notices: Derrick Riley Bursary ISAP Fund Information for contributors	10
Finding common ground: human and computer vision in archaeological prospection <i>by</i> Arianna Traviglia, Dave Cowley and Karsten Lambers	11
Automated detection in remote sensing archaeology: a reading list by  Karsten Lambers and Arianna Traviglia	25
The archaeological potential of declassified HEXAGON KH-9 panoramic camera satellite photographs by Martin J. F Fowler	30
Hillshades and High Drama by Rebecca Bennett	37
Cropmarks	40
"A set of old wives' tales": When Nadar was a photographer. Review article by Martyn Barber	43
Recovering lost landscapes. Review article by loana Oltean	46
Books of interest?  Efstratios Stylianidis and Fabio Remondino (ed), 2016. 3D Recording, Documentation and Management of Cultural Heritage.	49
Birger Stichelbaut and David Cowley (ed), 2016. Conflict Landscapes and Archaeology from Above.	
Dimitris Kaimaris and Petros Patias, 2015. Systematic observation of the change of marks of known buried archaeological structures: case study in the Plain of Philippi, Eastern Macedonia, Greece.	
W. Ostrowski and K. Hanus, 2016. Budget UAV systems for the prospection of small- and medium-scale archaeological sites.	
Evans, D., Airborne laser scanning as a method for exploring long-term socio-ecological dynamics in Cambodia.	
Archaeological Prospection 2016: list of 'aerial' papers	
AARG: general information, membership, addresses, student scholarships	52

## Automated detection in remote sensing archaeology: a reading list

Karsten Lambers<sup>1</sup>, Arianna Traviglia<sup>2</sup>

The applications of automated object detection in remote sensing archaeology have grown considerably in the last few years. This reading list has been compiled as a contribution to consolidating current perspectives at September 2016, and in support of the preceding paper on the broader issues of human and computer vision in archaeological prospection (Traviglia *et al.*).

- Agapiou A, Alexakis DD, Sarris A, Hadjimitsis DG. 2015. On the use of satellite remote sensing in archaeology. In *Best Practices of Geoinformatic Technologies for the Mapping of Archaeolandscapes*, Sarris A (ed.). Oxford: Archaeopress; 115–125.
- Beck A. 2007. Archaeological site detection: the importance of contrast. In *Remote Sensing* and *Photogrammetry Society Annual Conference (RSPSoc 2007): Challenges for Earth* Observation: Scientific, Technical and Commercial. Proceedings of a Meeting Held 11–14 September 2007, Newcastle Upon Tyne, UK. Nottingham: Remote Sensing and Photogrammetry Society; 307–312.
- Beck A, Wilkinson K, Philip G. 2007. Some techniques for improving the detection of archaeological features from satellite imagery. In *Remote Sensing for Environmental Monitoring, GIS Applications, and Geology VII, Proceedings of SPIE 6749*, Ehlers M, Michel U (eds.). Florence: SPIE; 674903. DOI: 10.1117/12.736704
- Bennett R, Cowley D, De Laet V. 2014. The data explosion: tackling the taboo of automatic feature recognition in airborne survey data. *Antiquity* 88: 896–905. DOI: 10.1017/S0003598X00050766
- Bevan A. 2015. The data deluge. Antiquity 89: 1473–1484. DOI: 10.15184/aqy.2015.102
- Casana J. 2014. Regional-scale archaeological remote sensing in the age of big data. *Advances in Archaeological Practice* 3: 222–233. DOI: 10.7183/2326-3768.2.3.222
- Cerrillo-Cuenca E. 2016. An approach to the automatic surveying of prehistoric barrows. *Quaternary International*, in press. DOI: 10.1016/j.quaint.2015.12.099
- Cheng G, Han J. 2016. A survey on object detection in optical remote sensing images. *ISPRS Journal of Photogrammetry and Remote Sensing* 117: 11–28. DOI: 10.1016/j.isprsjprs.2016.03.014
- Chen L, Comer DC, Priebe CE, Sussman D, Tilton JC. 2013. Refinement of a method for identifying probable archaeological sites from remotely sensed data. In *Mapping Archaeological Landscapes from Space*, Comer D C, Harrower M J (eds). New York: Springer; 251–258. DOI: 10.1007/978-1-4614-6074-9\_21

<sup>&</sup>lt;sup>1</sup> Leiden University: k.lambers@arch.leidenuniv.nl <sup>2</sup> Ca' Foscari University of Venice: traviglia@unive.it

- Cowley DC. 2012. In with the new, out with the old? Auto-extraction for remote sensing archaeology. In *Remote Sensing of the Ocean, Sea Ice, Coastal Waters, and Large Water Regions 2012, Proceedings of SPIE 8532*, Bostater CR, Mertikas SP, Neyt X, Nichol C, Cowley DC, Bruyant JB (eds.). Edinburgh: SPIE; 853206-1. DOI: 10.1117/12.981758
- Da Pelo P, D'Orazio T. 2013. Automatic and semi-automatic approaches to support archaeological trace extraction and digitalization. In *Proceedings of the 4<sup>th</sup> EARSeL Workshop on Cultural and Natural Heritage "Earth observation: a window on the past", Matera (Italy), 6–7 June 2013*, Lasaponara R, Masini N, Biscione M, Hernandez M (eds.); 347–362.
- De Boer A. 2007. Using pattern recognition to search LIDAR data for archeological sites. In *The World is in Your Eyes. CAA2005. Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 33<sup>rd</sup> Conference, Tomar, March 2005*, Figueiredo A, Leite Velho G (eds.). Tomar: CAA Portugal; 245–254.
- De Guio A, Magnini L, Bettineschi C. 2015. GeOBIA approaches to remote sensing of fossil landscapes: two case studies from northern Italy. In *Across Space and Time: Papers from the 41<sup>st</sup> Conference on Computer Applications and Quantitative Methods in Archaeology, Perth, 25–28 March 2013*, Traviglia A (ed.). Amsterdam: Amsterdam University Press; 45–53.
- De Laet V, Paulissen E, Waelkens M. 2007. Methods for the extraction of archaeological features from very high-resolution Ikonos-2 remote sensing imagery, Hisar (southwest Turkey). *Journal of Archaeological Science* 34: 830–841. DOI: 10.1016/j.jas.2006.09.013
- De Laet V, Mušič, Paulissen E, Waelkens M. 2008. Extracting archaeological features from very high resolution Quickbird-2 remote sensing imagery: a methodological approach based on the town of Sagalassos. In *Sagalassos VI. Geo- and Bio-Archaeology at Sagalassos and in its Territory*, Degryse P, Waelkens M (eds.). Leuven: Leuven University Press; 157–171.
- De Laet V, Paulissen E, Meuleman K, Waelkens M. 2009. Effects of image characteristics on the identification and extraction of archaeological features from Ikonos-2 and Quickbird-2 imagery: case study Sagalassos (southwest Turkey). *International Journal of Remote Sensing* 30(21): 5655–5668. DOI: 10.1080/01431160802705821
- D'Orazio T, Palumbo F, Cuaragnella C. 2012. Archaeological trace extraction by a local directional active contour approach. *Pattern Recognition* 45: 3427–3438. DOI: 10.1016/j.patcog.2012.03.003
- D'Orazio T, Da Pelo P, Marani R, Guaragnella C. 2015. Automated extraction of archaeological traces by a modified variance analysis. *Remote Sensing* 7: 3565–3587. DOI: 10.3390/rs70403565
- Figorito B, Tarantino E. 2014. Semi-automated detection of linear archaeological traces from orthorectified aerial images. *International Journal of Applied Earth Observation and Geoinformation* 26: 458–463. DOI: 10.1016/j.jag.2013.04.005
- Freeland T, Heung B, Burley DV, Clark G, Knudby A. 2016. Automated feature extraction for prospection and analysis of monumental earthworks from aerial LiDAR in the kingdom of Tonga. *Journal of Archaeological Science* 69: 64–74. DOI: 10.1016/j.jas.2016.04.011

- Hanson WS. 2008. The future of aerial archaeology (or are algorithms the answer?). In *Proceedings of the 1<sup>st</sup> International EARSeL Workshop on Remote Sensing for Archaeology and Cultural Heritage Management, CNR, Rome, September 30–October 4, 2008*, Lasaponara R, Masini N (eds.). Rome: Aracne; 47–50.
- Hanson WS. 2010. The future of aerial archaeology in Europe. *Photo Interprétation*. *European Journal of Applied Remote Sensing*, 46(1), 3–11.
- Harrower MJ, Schuetter J, McCorriston J, Goel PK, Senn MJ. 2013. Survey, automated detection, and spatial distribution analysis of cairn tombs in ancient southern Arabia. In *Mapping Archaeological Landscapes from Space*, Comer DC, Harrower MJ (eds.). New York: Springer; 259–268. DOI: 10.1007/978-1-4614-6074-9\_22
- Jahjah M, Ulivieri C. 2010. Automatic archaeological feature extraction from satellite VHR images. *Acta Astronautica* 66: 1302–1310. DOI: 10.1016/j.actaastro.2009.10.028
- Kobyliński Ł, Walczak K. 2006. Data mining approach to classification of archaeological aerial photographs. In *Intelligent Information Processing and Web Mining, Proceedings of the International IIS: IIPWM'06 Conference held in Ustrón, Poland, June 19*–22, 2006, Kłopotek MA, Wierzchoń ST, Trojanowski K (eds.). Berlin: Springer; 479–487. DOI: 10.1007/3-540-33521-8
- Kramer IC. 2015. An archaeological reaction to the remote sensing data explosion: reviewing the research on semi-automated pattern recognition and assessing the potential to integrate artificial intelligence. MSc thesis, University of Southampton. Available at <a href="https://drive.google.com/file/d/0ByV8MuuT2nnoSVhxa2VucHpnVjA/view?usp=sharing">https://drive.google.com/file/d/0ByV8MuuT2nnoSVhxa2VucHpnVjA/view?usp=sharing</a> [accessed 25-08-2016].
- Kvamme K. 2013. An examination of automated archaeological feature recognition in remotely sensed imagery. In *Computational Approaches to Archaeological Spaces*, Bevan A, Lake M (eds.). Walnut Creek: Left Coast Press; 53–68.
- Lambers K, Zingman I. 2013. Towards detection of archaeological objects in high-resolution remotely sensed images: the Silvretta case study. In *Archaeology in the Digital Era*, *Volume II E-Papers from the 40<sup>th</sup> Conference on Computer Applications and Quantitative Methods in Archaeology, Southampton, 26–30 March 2012*, Earl G, Sly T, Chrysanthi A, Murrieta-Flores P, Papadopoulos C, Romanowska I, Wheatley D (eds.). Amsterdam: Amsterdam University Press; 781–791.
- Lasaponara R, Masini N. 2012. Pattern recognition and classification using VHR data for archaeological research. In *Satellite Remote Sensing: A New Tool for Archaeology*,
   Lasaponara R, Masini N (eds.). New York: Springer; 65-85. DOI 10.1007/978-90-481-8801-7
- Lemmens JPMM, Stančič Z, Verwaal RG. 1993. Automated archaeological feature extraction from digital aerial photographs. In *Computing the Past. Computer Applications and Quantitative Methods in Archaeology. CAA92*, Andresen J, Madsen T, Scollar I (eds.). Aarhus: Aarhus University Press; 45–52.
- Liem VCG. 2014. Spaceborne Remote Sensing for Near Eastern Archaeology: A case study on archaeological site-detection in Jordan's Black Desert. MSc thesis, Delft University of Technology. Available at <a href="http://resolver.tudelft.nl/uuid:e863c6c6-852e-42d1-9053-9a014727e74b">http://resolver.tudelft.nl/uuid:e863c6c6-852e-42d1-9053-9a014727e74b</a>

- Megarry W P, Cooney G, Comer D C, Priebe C E. 2016. Posterior probability modeling and image classification for archaeological site prospection: building a survey efficacy model for identifying Neolithic felsite workshops in the Shetland Islands. *Remote Sensing* 8(6): 529. DOI:10.3390/rs8060529
- Menze BH, Ur JA. 2007. Classification of multispectral ASTER imagery in archaeological settlement survey in the Near East. In *Proceedings of the 10<sup>th</sup> International Symposium on Physical Measurements and Signatures in Remote Sensing (ISPMSRS'07), Davos, Switzerland, 12–14 March 2007, ISPRS Archives XXXVI-7/C50,* Schaepman M, Liang S, Groot N, Kneubühler M (eds.). Available at <a href="http://www.isprs.org/proceedings/XXXVI/7-C50/papers/P8.pdf">http://www.isprs.org/proceedings/XXXVI/7-C50/papers/P8.pdf</a> [accessed 25-08-2016].
- Menze BH, Ur JA. 2012. Mapping patterns of long-term settlement in northern Mesopotamia at a large scale. *PNAS* 109(14): E778–E787. DOI: 10.1073/pnas.1115472109.
- Menze BH, Mühl S, Sherratt AG. 2007. Virtual survey on north Mesopotamian tell sites by means of satellite remote sensing. In *Broadening horizons: multidisciplinary approaches to landscape study*, Ooghe B, Verhoeven G (eds.). Newcastle: Cambridge Scholars Publishing; 5–29.
- Menze BH, Ur JA, Sherratt AG. 2006. Detection of ancient settlement mounds: archaeological survey based on the SRTM terrain model. *Photogrammetric Engineering & Remote Sensing* 72(3): 321–327. DOI: 10.14358/PERS.72.3.321
- Redfern S. 1997. Computer assisted classification from aerial photographs. *AARGnews* 14: 33–38.
- Redfern S. 1998. An approach to automated morphological-topographical classification. *AARGnews* 17: 31–37.
- Redfern S. 1999. A PC-based system for computer assisted archaeological interpretation of aerial photographs. In *CAA97 Archaeology in the Age of the Internet: Computer Applications and Quantitative Methods in Archaeology*, Dingwall L, Exon S, Gaffney V, Laflin S, van Leusen M (eds.). Oxford: Archaeopress. CD-ROM; 17–24.
- Redfern S. 2004. Digital wide-area survey from aerial photographs. In *Making the Connection to the Past. CAA99. Computer Applications and Quantitative Methods in Archaeology: Proceedings of the 27<sup>th</sup> Conference, Dublin, April 1999, Fennema K, Kamermans H (eds.). Leiden: Faculty of Archaeology, Leiden University; 103–116.*
- Riley MA. Automated Detection of Prehistoric Conical Burial Mounds from LIDAR Bare-Earth Digital Elevation Models. Master's thesis, Department of Geology and Geography, Northwest Missouri State University, 2009. Available at <a href="http://www.nwmissouri.edu/library/theses/2009/RileyMelanie.pdf">http://www.nwmissouri.edu/library/theses/2009/RileyMelanie.pdf</a> [accessed 25-08-2016].
- Riley M A, Artz JA. 2012. Lidar Surveyor: a Tool for Automated Archaeological Feature Extraction from Light Detection and Ranging (Lidar) Elevation Data. Contract Completion Report 1898. Iowa City: Office of the State Archaeologist, The University of Iowa. Available at <a href="https://www.ncptt.nps.gov/download/28607/">https://www.ncptt.nps.gov/download/28607/</a> [accessed 25-08-2016].
- Schneider A, Takla M, Nicolay A, Raab A, Raab T. 2015. A template-matching approach combining morphometric variables for automated mapping of charcoal kiln sites. *Archaeological Prospection* 22: 45–62. DOI: 10.1002/arp.1497

- Schuetter J, Goel P, McCorriston J, Park J, Senn M, Harrower M. 2013. Autodetection of ancient Arabian tombs in high-resolution satellite imagery. *International Journal of Remote Sensing* 34(19): 6611–6635. DOI: 10.1080/01431161.2013.802054
- Sevara C, Pregesbauer M. 2014. Archaeological feature classification: an object oriented approach. *South-Eastern European Journal of Earch Observation and Geomatics* 3(2S): 139–143.
- Sevara C, Pregesbauer M, Doneus M, Verhoeven G, Trinks I. 2016. Pixel versus object a comparison of strategies for the semi-automated mapping of archaeological features using airborne laser scanning data. *Journal of Archaeological Science: Reports* 5: 485–498. DOI: 10.1016/j.jasrep.2015.12.023
- Trier ØD, Larsen SØ, Solberg R. 2009. Automatic detection of circular structures in high-resolution satellite images of agricultural land. *Archaeological Prospection* 16: 1–15. DOI: 10.1002/arp.339
- Trier ØD, Pilø LH. 2012. Automatic detection of pit structures in airborne laser scanning data. *Archaeological Prospection* 19: 103–121. DOI: 10.1002/arp.1421
- Trier ØD, Zortea M, Tonning C. 2015. Automatic detection of mound structures in airborne laser scanning data. *Journal of Archaeological Science: Reports* 2: 69–79. DOI: 10.1016/j.jasrep.2015.01.005
- Zingman I, Saupe D, Lambers K. 2012. Morphological operators for segmentation of high contrast textured regions in remotely sensed imagery. In *Proceedings of the IEEE International Geoscience and Remote Sensing Symposium, Munich, 22–27 July, 2012.* Munich: IEEE; 3451-3454. DOI: 10.1109/IGARSS.2012.6350678
- Zingman I, Saupe D, Lambers K. 2013. Automated search for livestock enclosures of rectangular shape in remotely sensed imagery. In *Image and Signal Processing for Remote Sensing XIX*, *Proceedings of SPIE 8892*, Bruzzone L (ed.). Dresden: SPIE; 88920F. DOI: 10.1117/12.2027704
- Zingman I, Saupe D, Lambers K. 2014. A morphological approach for distinguishing texture and individual features in images. *Pattern Recognition Letters* 47: 129–138. DOI: 10.1016/j.patrec.2014.03.019
- Zingman I, Saupe D, Lambers K. 2015. Detection of incomplete enclosures of rectangular shape in remotely sensed images. In 2015 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW). Boston: IEEE; 87–96. DOI: 10.1109/CVPRW.2015.7301387
- Zingman I, Saupe D, Penatti OAB, Lambers K. 2016. Detection of fragmented rectangular enclosures in very high resolution remote sensing images. *IEEE Transactions on Geoscience and Remote Sensing* 54: 4580–45. DOI: 10.1109/TGRS.2016.2545919.