

Dr Nicole Metje PhD, Dipl.-Ing, FHEA

Senior Lecturer

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About

Nicole Metje is a Senior Lecturer in Fluid Dynamics and Geotechnical Engineering.

Nicole has published 16 journal papers as well as over 20 refereed conference papers in the field of coastal and geotechnical engineering. She is the co-author of a book introducing tunnel construction aimed at MSc and MEng students or earlier career engineers.

Her research profile is increasing with successful grant applications and invited presentations, both nationally and internationally, for the Mapping the Underworld project. Her increasing international reputation is mirrored by invited memberships to the American Society of Civil Engineers (ASCE) utility standards committee as well as the US Transportation Research Board committee on utilities.

Qualifications

- Fellowship of the Higher Education Academy, 2009
- PhD Civil Engineering, University of Birmingham, 2001
- Dipl.-Ing. Civil Engineering (Bauingenieurwesen), Hannover University, Germany, 1998

Biography

Nicole Metje qualified with a Dipl.-Ing. In Civil Engineering from Hannover University, Germany in 1998 with the focus on fluid mechanics and tunnelling. She went on to study for a PhD in Sediment Suspension under Water Waves at the University of Birmingham, before joining the School of Electrical, Electronic and Computer Engineering as a Research Fellow in 2001. After 6 months, she joined the School of Civil Engineering as a Senior Research Fellow on a three year project to conduct research into optical fibre sensing technologies to determine the deformations of existing tunnels.

On the basis of her experience, Nicole was appointed as The Senior Postdoctoral Research Fellow in 2005 to co-ordinate the research activities of four discrete projects and a network funded research grant entitled Mapping the Underworld (MTU).

In 2007 Nicole was awarded a prestigious Birmingham Research Fellowship which transferred into the lectureship in coastal dynamics and geotechnical engineering in 2010.

Currently, she is a PI for a Pathways to Impact grant for the MTU project and CI for the MTU Phase 2 Location, the Detection of Archaeological residues using remote sensing technologies and the Smart Pipes projects.

Teaching

Foundation Year BEng/MEng

- Introductory Maths & Data Handling (20 credits, 15% involvement)
- Science & Engineering Mathematics – Fundamentals (20 credits, 10% involvement)

Third Year BEng/MEng

- River Basin Management (10 credits, 100% involvement, module leader)

MSc in Geotechnical Engineering

- Introduction to Tunnel Construction (10 credits, 60% involvement, module leader)

Postgraduate supervision

Currently, Nicole supervises the following research projects:

- Investigating the effect of silicon chips on the structural integrity of polymer (PhD, 2008 – 2011)
- Sustainability and street works: A complex balancing act (PhD, 2009-2011)
- Seasonal variations of the soil water content and its effects on geophysical surveys (PhD, 2010 – 2012)
- Relationship between geotechnical and acoustic soil properties (MPhil, 2010 – 2011)
- Effects of archaeological residues on geophysical soil properties (PhD, 2010 – 2013)

- Effects of archaeological residues on geotechnical soil properties (PhD, 2010 – 2013)
- Energy scavenging in the underground utility environment (PhD, 2010 – 2013)
- Communication and data management in the underground utility environment (PhD, 2010 – 2013)

In general, Nicole is interested in supervising doctoral research students in the following areas:

- Coastal engineering – sediment transport through gravel and sandy barriers
- Impacts of different soils on geophysical sensing technologies when locating buried utilities or archaeology
- Use of underground space – how can we make the underground space resilient and sustainable for the future and identify novel ways of using the space
- Novel sensing technologies for infrastructure monitoring (pipes, tunnels etc), such as Smart Pipes technology

If you are interested in studying any of these subject areas please contact Nicole on the contact details above, or for any general doctoral research inquiries, please e-mail civil-research@contacts.bham.ac.uk (<mailto:civil-research@contacts.bham.ac.uk>) or call +44 (0)121 414 4160.

Research

RESEARCH THEMES

Mapping the Underworld, Smart Pipes, Coastal Sediment Transport, Detection of archaeological residues

RESEARCH ACTIVITY

Mapping the Underworld & DART

The Mapping the Underworld initiative was first initiated in 1996 when the term 'Body Scanner in the Street' was coined. This was followed with an EPSRC ideas factory in 2004 and the feasibility project started in 2005 investigating the abilities and limitations of a range of locating technologies to locate all buried utilities in all ground conditions, look at alternative technologies as well as investigate the mapping and data fusion of utility records.

The feasibility study showed that a number of technologies have the potential to locate buried assets when used in combination and also combined with some information on the soil to optimise any survey strategies. This led to the MTU Phase 2 Location project (2009-2012) with the focus of this project on the development of a multi-sensor device to locate all buried utilities in all ground conditions using Ground Penetrating Radar (GPR), low frequency electromagnetics, vibro acoustics and leakage current fields. In addition, the project aims to develop specifications for a National Test Facility and after presenting at the No Dig Roadshow in December 2009, a contractor came forward who had an interest in developing a UK test site and is now in the process of starting construction worth approximately £1.0m. The MTU idea is a 25 year vision with both condition assessment using a multi-sensor device and sustainable use of the underground infrastructure being addressed in the future.

Although the MTU project focuses on the location of buried utilities, this can then be expanded to archaeological residues. This led to the DRAT project (2010-2013), which aims to further the MTU approach to other geophysical surveying technologies. However, they all have in common that they need to transmit through the ground and hence prior knowledge of the ground can lead to the optimisation of survey strategies and technologies.

Smart Pipes

The interest in monitoring and mapping of underground infrastructure led to a project in 2006 funded by UK Water Industry Research (UKWIR), the American Water Research Foundation (WRF) and the University of Birmingham on which Nicole was a co-investigator. The project (Smart Pipes) researches smart sensor technologies using micro/nano sensors to investigate the condition of underground utility pipelines. These sensors would provide additional information on the condition of buried pipes so that any management strategies can be proactive. It culminated in the burial of a "Smart Pipe" demonstrator with successful data retrieval proving the concept of this approach. Follow on funding has been secured from UKWIR with Phase 2 starting in October 2010 and negotiations are underway with WRF for further follow on funding from next year's budget allocations; the Americans are retaining a strong interest in this work.

BARDEX (Gravel Barrier Dynamics)

Whenever time and funding allows, Nicole is interested in sediment transport and sediment suspension under water waves. In 2008, she was involved in a European project analysing the stability of gravel barriers with experiments conducted in the large Deltares waveflume (230m long, 7m deep, 5m wide) in Holland.

Other activities

- International member of the Transport Research Board (TRB), ABF70 Utility Committee
- Member of the All Party Parliamentary Water Group, since 2010
- International member of the ASCE Utility standards committee, since 2009
- Marker/Moderator at the University of Birmingham on the Postgraduate Teaching Certificate in Learning and Teaching, since 2007

Publications

Books

Chapman D., Metje, N., Stärk, A. (2010). Introduction to Tunnel Construction. Applied Geotechnics Volume 3, Spon Press, ISBN 978-0-415-46842-8. 400 pages.

Selected Journal Papers

Williams, J.J., Bell, P.S., Coates, L.E., Metje, N., Selwyn, R. (2003). Interactions between a benthic tripod and waves on a sandy bed. *Continental Shelf Research*, Vol. 23, 3-4, pp. 355-375.

Williams, J. J., Bell, P. S., Thorne, P.D., Metje, N., Coates, L. E. (2004). Measurement and prediction of wave-generated suborbital ripples. *Journal of Geophysical Research*, Vol. 109. CO2004. doi:10.1029/2003JC001882. pp. 1-18.

Miao, P., Kukureka, S.N., Metje, N., Chapman, D.C., Rogers, C.D.F., Henderson, P. (2007). Mechanical reliability of a novel optical-fibre sensor system for tunnel displacement monitoring. *Smart Materials and Structures*, 16, Issue 2, pp. 382-390.

Williams, J.J., Metje, N., Coates, L.E., Atkins, P.R. (2007). Sand Suspension by Vortex Pairing. *Geophysical Research Letters*, Vol. 34, No. 15, L15603, doi 10.1029/2007/GL030761.

Costello, S.B., Chapman, D.N., Rogers, C.D.F., Metje, N. (2007). Underground Asset Location and Condition Assessment. *Tunnelling and Underground Space Technology*. Vol. 22, No. 5-6, pp. 524-542.

Metje, N., Atkins, P.R., Brennan, M.J., Chapman, D.N., Lim, H.M., Machell, J., Muggleton, J.M., Pennock, S., Ratcliffe, J., Redfern, M., Rogers, C.D.F., Saul, A.J., Shan, Q., Swinger, S., Thomas, A.M. (2007). Mapping the Underworld – State-of-the-art review. *Tunnelling and Underground Space Technology*. Vol. 22, No. 5-6, pp. 568-586.

Metje, N., Chapman, D.N., Rogers, C.D.F., Henderson, P., Beth, M. (2008). Optical Fibre Sensors for Remote Tunnel Displacement Monitoring – Prototype Tests in the

Metje, N., Sterling, M, Baker, C.J. (2008). Pedestrian comfort using clothing values and body temperatures. *Journal of Wind Engineering & Industrial Aerodynamic*, Vol. 96, pp. 412 – 435.

Metje, N., Little, G.H., Kamtekar, A.G., Chapman, D.N. (2008). Finding displacements from measured strains in beams and framed structures. *Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics*, Vol. 161, Issue EM4, pp. 157 – 167.

Thomas, A.M., Chapman, D.N., Rogers, C.D.F., Metje, N., Atkins, P.R., Lim, H.M. (2008). Broadband apparent permittivity measurement in dispersive soils using quarter-wavelength analysis. *Soil Science Society of America Journal*, Vol. 72, No. 5, pp. 1401-1409.

Thomas, A.M., Chapman, D.N., Rogers, C.D.F., Metje, N. (2010). Electromagnetic Properties of the Ground: Part I – Fine-Grained Soils at the Liquid Limit. *Tunnelling and Underground Space Technology*, Vol. 25, No. 6, doi:10.1016/j.tust.2009.12.002, pp. 714-722.

Thomas, A.M., Chapman, D.N., Rogers, C.D.F, Metje, N. (2010). Electromagnetic Properties of the Ground: Part II – Properties of Two Selected Fine-Grained Soils. *Tunnelling and Underground Space Technology*, Vol. 25, No. 6, doi:10.1016/j.tust.2009.12.003, pp. 723 – 730.

Royal, A.C.D., Atkins P.R., Brennan, M.J., Chapman, D.N., Chen, H., Cohn, A.G., Foo, K.Y., Goddard, K., Hayes, R., Hao, T., Lewin, P.L., Metje, N., Muggleton, J.M., Naji, A., Orlando, G., Pennock, S.R., Redfern, M.A., Saul, A.J., Swingler, S.G., Wang, P., Rogers C.D.F. (accepted). Site Assessment of Multiple Sensor Approaches for Buried Utility Detection. *International Journal of Geophysics*.

