

## **PIETER POOLMAN, PH.D.**

Health Science Specialist  
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Research Scientist  
University of Iowa  
Iowa City, IA 52242 USA  
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### **EDUCATION**

B.Eng. Civil Engineering, University of Stellenbosch, South Africa, 1996  
M.Eng. Civil Engineering (Traffic Engineering), University of Stellenbosch, 1998  
Ph.D. Civil Engineering (Traffic Engineering), University of Stellenbosch, 2003

### **CURRENT POSITIONS**

Health Science Specialist, Iowa City Department of Veterans Affairs (VA) Medical Center  
Research Scientist, Department of Ophthalmology and Visual Sciences, University of Iowa  
Adjunct Assistant Professor, Department of Biomedical Engineering, University of Iowa

### **EXPERIENCE**

- Research Assistant, Institute of Transportation Technology, University of Stellenbosch, 1997
- Research Engineer, Center of Transportation Research, University of Texas, 1998–1999
- Research Engineer, Institute of Transportation Technology, University of Stellenbosch, 2000–2002
- Post Doctoral Researcher, Department of Industrial Engineering, University of Iowa, 2003–2004
- Scientist, Electrical Geodesics, Inc. (EGI), 2004–2007
- Research Engineer, Center for Computer-Aided Design, University of Iowa, 2008–2009

As a scientist and engineer, Dr. Poolman has performed research in the fields of physiometrics, neuropsychology, operator behavior modeling, accident analyses, highway operations, road alignment, and pavement testing over the past 12 years.

While working at the Center of Transportation Research of the University of Texas, he developed concepts to improve operational flexibility of highway systems based on accident analyses and cost/benefit studies. At the University of Stellenbosch, he conducted pavement performance experiments through accelerated testing and gained extensive experience in experimental design, multivariate analysis, and mathematical modeling.

As part of his Master's thesis, he developed a new standard for the design of both horizontal and vertical curves in highway alignment. The study was based on safety aspects of both sight and stopping distances and principles of microscopic simulation of traffic flow. Dr. Poolman's dissertation covered many topics on human factors in driver behavior modeling, based on brain functioning. From his study, insights on driver issues of visibility, risk taking, decision-making processes, and automatized tasks were redefined in terms of neurophysiological principles.

His work at EGI included several Department of Defense (DOD) and National Institutes of Health (NIH) projects for studying cognitive performance monitoring and enhancement, together with head modeling and conductivity scanning for tracking epilepsy. Currently, his research is focused on the

continuation of the development of algorithms and software tools for localizing areas of activity in the brain from electroencephalography (EEG) measurements, including aspects of joint time-frequency analyses and Bayesian priors. This suite of tools is used in studying human operator behavior from a neuropsychological viewpoint for National Aeronautics and Space Administration (NASA), DoD, and industry-funded projects. His other research work includes functional brain imaging, combined EEG/eye-tracking/psychophysiology measurements, forward and inverse modeling, signal processing, artifact detection and extraction, coherence measures, and high-performance computing. Together these topics form the bases of real-time human performance tracking and analysis.

## SCIENTIFIC AND PROFESSIONAL SOCIETIES

- 2004 – present: Member of the Transportation Research Board (TRB) Committee for Vehicle User Characteristics (AND10), National Research Council.
- 2007 – present: Member of the Human Factors and Ergonomics Society (HFES) Augmented Cognition Technical Group.
- 2007 – present: Reviewer for NeuroImage (journal).

## AWARDS

- 1996 ECSA (Engineering Council of South Africa) Medal for Best B.Eng. Graduated by Merit at University of Stellenbosch
- 1996 ESKOM Prize for Best B.Eng. Graduated by Merit in South Africa
- 1997 NRF (National Research Foundation South Africa) Fellowship for Master's studies
- 1998 H.L. Reitz Medal for Best Graduate Student (Master's) in Civil Engineering at University of Stellenbosch
- 1999 IRF (International Road Federation) Fellowship for Exchange Program at University of Texas at Austin
- 1999 NRF (National Research Foundation South Africa) Fellowship for Ph.D. studies
- 2003 H.L. Reitz Medal for Best Graduate Student (Ph.D.) in Civil Engineering at University of Stellenbosch
- 2003 NRF (National Research Foundation South Africa) Fellowship for Post Doctoral studies at the University of Iowa
- 2006 2<sup>nd</sup> Annual Foundations of Augmented Cognition Award Recipient

## PUBLICATIONS

1. Poolman, P.; Bester, C.J. (2000). *Towards a New Approach for the Design of the Alignment of Highways and Railroads*. Proceedings of the 2nd International Symposium on Highway Geometric Design, Mainz, Germany.
2. Machemehl, R.B.; Rioux, T.W.; Tsyganov, A.; Poolman, P. (2001). *Freeway Operational Flexibility Concepts*. Project Summary Report 1844-S, University of Texas, Austin, TX.
3. Hugo, F.; Poolman, P. (2001). *A Critical Analysis of WesTrack MMLS3 and Truck Rut Data*. Appendix A in FHWA/TX-01/2134-1, Texas Department of Transportation, Austin, TX.
4. Hugo, F.; Poolman, P. (2001). *A Critical Review of the Quantitative Analysis of MMLS3 and Truck Rutting Performance at WesTrack*. Appendix B in FHWA/TX-01/2134-1, Texas Department of Transportation, Austin, TX.
5. Martin Epps, A.; Ahmed, T.; Little, D.C.; Hugo, F.; Poolman, P.; Mikhail, M. (2002). *Performance prediction with the MMLS3 at WesTrack*. Proceedings of the Ninth International Conference on Asphalt Pavements, Copenhagen.
6. Schnell, T.; Lee, J.; Phohom, T.; Lee, Y.; Poolman P. (2002), *Determining And Assessing Level of Fun and Workload Based On Physiological Patterns*. Final Report, Honda R&D Americas, ITR, Detroit Office, 1000 Town Center, Suite 2050, Southfield, MI 48075.

7. Poolman, P.; Bester C.J. (2003). *Towards an Experimental Platform for Future Driver Behavior Research based on the Integration of Engineering and Neuroscientific Know-How*. Proceedings of the 82<sup>nd</sup> Annual Meeting of the Transportation Research Board, Washington D.C.
8. Poolman, P.; Tucker, D.M.; Luu, P.; Schnell, T.; Aktan, F. (2005). *An Experiment to Probe Brain Responses to Driver Information Systems*. Proceedings of the 1<sup>st</sup> International Conference on Augmented Cognition, Las Vegas, USA.
9. Tucker, D.M.; Poolman, P.; Luu, P. (2005). *On-line Corrections of Artifacts in Cognitive State Gauges*. Proceedings of the 1<sup>st</sup> International Conference on Augmented Cognition, Las Vegas, USA.
10. Russell, G.S.; Eriksen, K.J.; Poolman, P.; Luu, P.; Tucker, D.M. (2005). *Geodesic Photogrammetry for Localizing Sensor Positions in Dense-Array EEG*. *Clinical Neurophysiology*, 116: 1130-1140.
11. Salman, A.; Turovets, S.; Malony, A.; Poolman, P.; Davey, C.; Eriksen, K.J.; Tucker, D.M. (2006). *Noninvasive Conductivity Extraction for High-Resolution EEG Source Localization*. *Advances in Clinical Neuroscience and Rehabilitation*, 6(1): 27-28.
12. Turovets, S.; Salman, A.; Malony, A.; Poolman, P.; Davey, C.; Tucker, D.M. (2006). *Anatomically Constrained Conductivity Estimation of the Human Head Tissues in Vivo: Computational Procedure and Preliminary Experiments*. World Congress on Medical Physics and Biomedical Engineering, Seoul, South Korea.
13. Schnell, T.; Poolman, P.; Macuda, T. (2006). *Toward the "Cognitive Cockpit": Flight Test Platforms and Methods for Monitoring Pilot Mental State*. Proceedings of the 2<sup>nd</sup> International Conference on Augmented Cognition, San Francisco, USA.
14. Schnell, T.; Macuda, T.; Poolman, P.; Keller, M. (2006). *Workload Assessment in Flight Using Dense-Array EEG*. Proceedings of the 25<sup>th</sup> Digital Avionics Systems Conference, Portland, USA.
15. Poolman, P.; Frank, R.M.; Bell, R.M.A.; Tucker, D.M.; Luu, P. (2006). *Advanced Integrated Real-time Artifact Removal Framework*. In D.D. Schmorow, K.M. Stanney, L.M. Reeves (Eds.), *Foundations of Augmented Cognition* (pp. 102-110). San Ramon: Falcon Books.
16. Poolman, P.; Frank, R.M.; Luu, P.; Pederson, S.M.; Tucker, D.M. (2008). *A Single-Trial Analytic Framework for EEG Analysis and its Application to Target Detection and Classification*. *NeuroImage*, 42: 787-798.
17. Poolman, P.; Turovets, S.I.; Frank, R.M.; Russell, G.S. (2008). *Instrumentation and Signal Processing for Low-frequency Bounded-EIT Studies of the Human Head*. IEEE International Instrumentation and Measurement Technology Conference, Victoria, Canada.
18. Turovets, S.I.; Poolman, P.; Salman, A.; Malony, A.D.; Tucker, D.M. (2008). *Conductivity analysis for high-resolution EEG*. Proceedings of the IEEE International Conference on Biomedical Engineering and Informatics (BMEI).
19. Poolman, P.; Frank, R.M.; Turovets, S.I. (2008). *Modified lock-in detection for extraction of impressed EEG signals in low-frequency bounded-EIT studies of the human head*. Proceedings of the IEEE International Conference on Image and Signal Processing (CISP).
20. Poulsen, C.; Luu, P.; Crane, S.M.; Quiring, J.; Poolman, P.; Tucker, D.M. (submitted). *Clues to Neural Mechanisms of Self-Evaluation in Anxiety and Depression*. *Journal of Abnormal Psychology*.
21. Schnell, T.; Keller, M.; Poolman, P. (2008). *Quality of Training Effectiveness Assessment (QTEA): A Neurophysiologically Based Method to Enhance Flight Training*. Proceedings of the 27<sup>th</sup> Digital Avionics Systems Conference, St. Paul, USA.
22. Schnell, T.; Keller, M.; Poolman, P. (2008). *Neurophysiological Workload Assessment in Flight*. Proceedings of the 27<sup>th</sup> Digital Avionics Systems Conference, St. Paul, USA.
23. Poolman, P.; Schnell, T.; Melzer, J.E.; Robbins, S. (accepted). *The Cognitive Pilot Helmet: enabling pilot-aware, smart avionics*. SPIE Defense, Security, and Sensing Conference, Orlando, USA.

## PRESENTATIONS

2007 Plenary speaker at the 44<sup>th</sup> Annual Rocky Mountain Bioengineering Symposium, Denver, CO.

## PAST AND CURRENT PROJECTS

1996 – 1997: National Research Foundation (South Africa) Project: Development of a new standard for the design of both horizontal and vertical curves in highway alignment. The study was based on safety aspects of both sight and stopping distances and principles of microscopic simulation of traffic flow.

1998 – 1999: Texas Department of Transportation Research Project: Development of a set of concepts to improve operational flexibility of highway systems, based on accident analyses and cost/benefit studies.

2000 – 2002: Texas Department of Transportation/Alabama Department of Transportation Research Project: Pavement performance experiments based on accelerated testing, multivariate analysis, and mathematical modeling are conducted.

1999 – 2002: National Research Foundation (South Africa) Project: Conducting an investigation into the application of novel strategies to model driver behavior.

2003 – 2005: National Research Foundation (United States of America) Project: Application of principles on brain imaging and modeling to probe the cognitive and emotional processes of drivers.

2004 – 2005: Defense Advanced Research Projects Agency (DARPA) *Augmented Cognition (AugCog)*: Improving Warfighter Information Intake Under Stress.

2004 – 2008: Develop, design, and program the computational engine (library) of **GeoSource**, the electrical source localization software offered by EGI. Library modules included forward modeling, and many flavors of distributed inverse modeling (LORETA, Laura, FOCUS, etc.).

2005 – 2006: DARPA *Integrative Platform for Cognitive Workload Assessment (CogWorkload)*: Development of the EEG Cognitive Workstation to allow real-time monitoring of an operator's verbal and special working memory.

2005 – 2006: Office of Naval Research (ONR)/DARPA *Neural Control of Actions in Contexts*: Characterization of the neural mechanisms that achieve the development of expert performance.

2005 – 2006: DARPA/National Geospatial-Intelligence Agency (NGA) *Neurotechnology for Intelligence Analysts (NIA)*: Development of an image recognition intelligence system to improve the throughput of imagery to image analysts and improve the accuracy of their assessments.

2005 – 2007: DARPA *Virtual Reality Training Environment (VIRTE)*: Assessment of the human learning process, with the goal to differentiate between two types of errors: slips of actions and mistakes.

2005 – 2008: Denso *Driver Workload and Stress Assessment using Physiological Measurements*.

2006 – 2008: U.S. Army Medical Research Acquisition Activity (USAMRAA) *Simultaneous EEG Acquisition and Portable Near-Infrared Spectroscopy for Recognition of Traumatic Brain Injury Severity and Outcome Assessments in Far-Forward Military Medical Care (TBI)*: Use of simultaneous EEG and near-infrared

spectroscopy (NIRS) for rapid assessment of neural pathology in traumatic brain injuries in field and emergency settings.

2006 – 2008: NIH *Conductivity for High Resolution EEG*: Development of a conductivity scanning system to provide accurate estimates of the conductivity of human head tissues that aids in the analysis of the brain's electrical activity with EEG and yields improved information about the brain for both research and medical applications.

2007 – 2008: NASA *Integrated Intelligent Flight Deck (IIFD)*: Development of monitoring systems of operator cognitive state and mitigations for operator-, automation-, and environment-induced hazards for future operational concepts.

2007 – 2008: ONR *Physiological-based Tools for Virtual Environment Fidelity Design Guidance*: Development of training assessment and guidance tools that utilize operator behavior and physiology to determine virtual environment (VE) effectiveness and transfer of training.

2008 – 2008: Rockwell Collins *Pilot Helmet Sensor Instrumentation*: Integration of a physiological-based sensor system (EEG, head and eye tracking, oxymetry, etc.) into an aviator helmet for measuring physiological and cognitive states.

## REFERENCES

1. Randy H. Kardon M.D. Ph.D., Professor, Department of Ophthalmology and Visual Sciences, University of Iowa; [email: randy-kardon@uiowa.edu](mailto:randy-kardon@uiowa.edu)
2. Sergei Turovets Ph.D., Physicist, Neuroinformatics Center, University of Oregon; [email: sergei@cs.uoregon.edu](mailto:sergei@cs.uoregon.edu)
3. Robert M. Frank, Mathematician, Neuroinformatics Center, University of Oregon; [email: rmfrank@mac.com](mailto:rmfrank@mac.com)
4. Jason M. Quiring Ph.D., Neuropsychologist, Oregon State Hospital; [email: jason.quiring@state.or.us](mailto:jason.quiring@state.or.us)
5. Fred Hugo Ph.D., Professor, Department of Civil Engineering, University of Stellenbosch; [email: fhugo@sun.ac.za](mailto:fhugo@sun.ac.za)