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EDUCATION

Ph.D., Robotics.

[Carnegie Mellon University](#), Pittsburgh, PA.

Defended
11/2000

Committee: Martial Hebert (chair), William "Red" Whittaker, Andrew Moore, Reid Simmons and Peter Cheeseman (NASA Ames Research Center).

Dissertation: *Robotic Rock Classification for Autonomous Geological Exploration.*

My thesis demonstrates the application of Bayesian statistics to the problem of autonomous geological exploration with a robotic vehicle. It concentrates on the sub-problem of classifying rock types while addressing the issues associated with operating onboard a mobile robot, and argues that the Bayesian statistical paradigm, using a Bayes network generative statistical model of the geological environment, is particularly suited to this task. This paradigm is extended in a natural way to solve the more general robotic problems of autonomously profiling an area, exploiting dependencies between distinct samples to improve their classification, and allocating scarce sensor resources.

I implemented the rock classifier developed in my thesis onboard Carnegie Mellon University's Nomad robot, along with appropriate sensors, and demonstrated it in Antarctica in January 2000 when Nomad made the first ever autonomous identification of a meteorite by a robot.

M.S.E.E., Robotics and Automation

[George Washington University](#), Washington, DC.

8/1995

B.Sc.Hons. Physics with Electronics and Computer Science

B.Sc., Physics with Electronics, Computer Science, Mathematics, Applied Mathematics

[Rhodes University](#), South Africa.

12/1992

12/1991

Achieved 4 majors with distinctions in each. Emphasis on theoretical physics, electronics and pattern classification

AWARDS AND SCHOLARSHIPS

Ph.D. Graduate Fellowship, Robotics Institute, C.M.U.

9/95 – 3/01

Fulbright Scholarship for M.S. degree at George Washington University

9/93 – 5/95

George Washington University tuition waiver

9/93 – 5/95

Foundation for Research and Development (FRD) Masters degree scholarship (declined)

1993

Muirhead Scholarship (declined)

1993

Masters degree scholarship (declined)

1993

Basil Schonland Prize for Physics

1993

Academic Colours for B.Sc.Hons. Degree	1992
David Williams Memorial Prize for Mathematics	1992
Dr. Kendal Scholarship	1992
Foundation for Research and Development (FRD) postgraduate scholarship	1992
Teaching Assistantship bursary	1992
Nominated for Genmin Prize in Computer Science	1992
Academic Honours for distinctions in all 4 majors of B.Sc. degree	1991
Rhodes University Scholarship	1991
R. B. Hagart Bursary	1991
Academic Half Colours	1990
Rhodes University Scholarship	1990
R. B. Hagart Bursary	1990
Academic Half Colours	1989
Rhodes University Special Bursary	1989

EMPLOYMENT EXPERIENCE

NASA Ames Research Center , California, USA.	5/99 – 9/99
Joint Research Interchange (JRI) program fellow.	6/98 – 9/98
Researched autonomous rock identification from a planetary rover platform using reflectance spectra and color imagery. Developed the Bayes network based rock classifier that was deployed in Antarctica on CMU's Nomad robot to search for meteorites. Liaison between space science (geology and astrobiology) community and CMU robotics community.	
NASA Ames Research Center , California, USA.	8/97 - 10/97
Researcher for "Graduate Student on Mars" project.	
Researched reflectance spectroscopy and spectrometers for geological exploration using robotic planetary rovers. Liaison to the Carnegie Mellon University research effort on planetary rovers, resulting in joint research in Antarctica.	
Albany Museum , Grahamstown, South Africa.	2/93 - 5/93
Designed and built a three-floor computer controlled Foucault Pendulum exhibit.	

FIELD & RESEARCH EXPERIENCE

Antarctica 2000 Expedition.	1/00
http://www.frc.ri.cmu.edu/projects/meteorobot/exp2k	
Graduate Research.	
Demonstration of autonomous robotic meteorite search with Nomad robot at Elephant Moraine, Antarctica, using rock classification system (sensors and Bayes network based architecture) developed for Ph.D. thesis.	
Antarctica 1998 Expedition.	11/98 - 12/98
http://www.frc.ri.cmu.edu/projects/meteorobot	
Graduate Research.	
Deployment of Nomad robot in Antarctica to test its ability to operate in the polar environment and to conduct meteorite search tests with rover-mounted instruments while robot was teleoperated.	

- NASA Mars-Haughton Expedition** 7/98
<http://www.arctic-mars.org/>
 Graduate Research.
 Spectroscopic studies of rock at Haughton impact crater in Devon Island, a site in the Canadian Arctic considered geologically analogous to Mars and therefore interesting for the development of future Mars rovers. This work was featured in the July 1999 issue of **National Geographic Magazine**.
- Antarctica 1997 Expedition.** 1/98
<http://www.cs.cmu.edu/~meteorite/Antarctica97>
 Graduate Research.
 Field deployment and testing of sensors and equipment for robotic meteorite search in the Patriot Hills region of Antarctica.
- Atacama Desert Trek** 6/97
<http://www.ri.cmu.edu/atacama-trek/>
 Graduate Research.
 Developed and deployed a metal detector and magnetometer suite on the Nomad robot for meteorite search experiments in the Atacama desert, Chile.
- Lunar Telescope Deployment Project.** 1996
<http://www.cs.cmu.edu/afs/cs/project/tscope/www/tscope.html>
 Graduate Research.
 CMU project to develop rovers for deployment of a multi-element optical lunar observatory. Developed basic concept and precision optical pointing system. Project was cancelled.
- South African National Antarctic Expedition.** 12/89 - 2/90
<http://home.intekom.co.za/sanae>
 Research Assistant
 Provided logistical support with the decommissioning of the Rhodes University ionosonde at SANAE base, Antarctica, during the annual summer re-supply voyage.
- South African Astronomical Observatory (SAAO).** 1/91
<http://www.saa.ac.za/>
 Research Assistant.
 Designed computer programs for telescope calibrations.
- Hartebeeshoek Radio Astronomy Observatory (HartRAO).** Intermittently
<http://www.hartrao.ac.za/> '89 - '92
 Research Assistant.
 Built electronic circuits for radio telescope.

TEACHING EXPERIENCE

Teaching assistant for Robotic Art Studio course, Carnegie Mellon University, 1997. A joint course between the Robotics Institute and the CMU Art Department on the use of robotic and mechatronic media for artistic purposes. I taught basic electronics and micro-controller programming.

Teaching assistant for 1st year Physics and Electronics, Rhodes University, 1992.

PROFESSIONAL ACTIVITIES

Member of Institute for Electrical and Electronics Engineers (IEEE).

Attended JPL/Caltech 2000 *Planetary Science Summer School* on "Discovery micromissions: Focused Low-Cost Science", August 7-11, 2000.

MISCELLANEOUS INFORMATION

Fluent in English and Spanish; elementary knowledge of French and Japanese.

Instrument rated private pilot, with complex and hi-performance aircraft endorsements.

PUBLICATIONS

Articles and Chapters:

D. Apostolopoulos, M.D. Wagner, B.N. Shamah, L. Pedersen, K. Shillcutt, W.L. Whittaker, "Technology and Field Demonstration of Robotic Search for Antarctic Meteorites" in *International Journal of Robotic Research*, special Field & Service Robotics issue, November 2000.

Cabrol, N. A. and E. A. Bettis III, B. Glenister, G. Chong, C. Herrera, A. Jensen & M. Pereira, C. R. Stoker, E. A. Grin, V. C. Gulick, R. Landheim, P. Lee, T. L. Roush, A. P. Zent, J. M. Dohm, R. Keaten, G. C. Dunfield, G. Thomas, J. Golden, K. Saville, G. Ludvigson, and B. Witzke, D. Wettergreen, D. Christian, M. H. Sims, K. Schwehr, L. Pedersen, M. G. Bualat, H. J. Thomas, and E. Zbinden "Nomad Rover Field Experiment, Atacama Desert, (Chile) II. Identification of Paleolife Evidence Using A Robotic Vehicle: Lessons and Recommendations for a Mars Sample Return Mission" in *Journal of Geophysical Research*, in press 2000.

Abstracts, Proceedings and Reviews:

L. Pedersen, "Autonomous Characterization of Unknown Environments", submitted to *IEEE International Conference on Robotics and Automation 2001*, Seoul, Korea, 2001

L. Pedersen, M. Wagner, D. Apostolopoulos, and W.L. Whittaker, "Autonomous Robotic Meteorite Identification in Antarctica", submitted to *IEEE International Conference on Robotics and Automation 2001*, Seoul, Korea, 2001

D. Apostolopoulos, L. Pedersen, B. Shamah, K. Shillcutt, M. Wagner, W.L. Whittaker, "Robotic Antarctic Meteorite Search: Outcomes", submitted to *IEEE International Conference on Robotics and Automation 2001*, Seoul, Korea, 2001

L. Pedersen, D. Apostolopoulos, W.L. Whittaker "Bayes Networks on Ice: Robotic Search for Antarctic Meteorites", *Neural Information Processing Symposium 2000*, Denver, Colorado, 2000

L. Pedersen, D. Apostolopoulos, W. Whittaker, W. Cassidy, P. Lee and T. Roush "Robotic Rock Classification Using Visible Light Reflectance Spectroscopy: Preliminary results from the Robotic Antarctic Meteorite Search program", presented at *Lunar and Planetary Science Conference XXX*, Houston, Texas, 1999.

T.L. Roush, V. Gulick, R. Morris, P. Gazis, G. Benedix, C. Glymour, J. Ramsey, L. Pedersen, M. Ruzon, W. Buntine, and J. Oliver "Autonomous Science Decisions for Mars Sample Return", presented at *Lunar and Planetary Science Conference XXX*, Houston, Texas, 1999.

P. Lee, W.A. Cassidy, D. Apostolopoulos, D. Bassi, L. Bravo, H. Cifuentes, M. Deans, A. Foessel, S. Moorehead, M. Parris, C. Puebla, L. Pedersen, M. Sibenac, F. Valdés, N. Vandapel, and W. L. Whittaker "Search for Meteorites at Martin Hills and Pirrit Hills, Antarctica", presented at *Lunar and Planetary Science Conference XXX*, Houston, Texas, 1999.

Liam Pedersen "Robotic Deployment of Electro-Magnetic Sensors for Meteorite Search". Proceedings of the *IEEE International Conference on Robotics and Automation*. Leuven, Belgium, 1998.

L. Pedersen, D. Apostolopoulos, W. Whittaker, T. Roush and G. Benedix "Sensing and data classification for robotic meteorite search", in proceedings of *SPIE Photonics East Conference*. Boston, USA, 1998.

P., Lee, W. A. Cassidy, D. Apostolopoulos, M. Deans, A. Foessel, C. Krause, S. Parra, L. Pedersen, K. Schwehr, and W.L. Whittaker "Search for meteorites in the Patriot Hills area, Ellsworth Mountains, West Antarctica", presented at *61st Meteoritic Society Meeting.*, Dublin, Ireland, July 1998. Abstract in *Meteoritics & Planetary Science*, 33 Supplement, A92-A93.

L. Pedersen and F.A.M. Frescura "Galilean Space-Time and Classical Mechanics", presented at *South African Institute of Physics Conference*, Johannesburg, South Africa, 1992.

Invited Lectures:

NASA Ames Research Center, invited lecture on "Robotic Exploration and Rock Classification", August 13, 1999. (<http://ack.arc.nasa.gov:80/hypermail-external/seminars/0022.html>)

Monterrey Bay Aquarium Research Institute Seminar Series, invited lecture on "Robotic Rock Classification and Meteorite Search", July 23, 1999 (http://www.mbari.org/itd/seminars/past99seminars/Jul_23_99.html)

Carnegie Mellon University Workshop on Polar Robotics (coincident with FSR '99), seminar on "Automatic Classification of Antarctic Rocks and Meteorites", August 28, 1999.

National Public Radio syndicated radio show *Beyond Computers*, interview on "Robots", USA national broadcast November 17, 1999. (http://www.beyondcomputers.org/nov_1799.html)

Australian National University Robotic Systems Lab (Department of Systems Engineering) invited seminar on "Robotic Search for Antarctic Meteorites", February 23, 2000. Sydney University Australian Center for Field Robotics, invited seminar on "Robotic Search for Antarctic Meteorites", February 25, 2000.

Jet Propulsion Laboratory, Pasadena, California, invited job talk on "Autonomous Science and Robotic Meteorite Search", August 14, 2000.