

Publications & Patents

Damian M. Lyons, September 2012

SUMMARY

1. Recently submitted/accepted:	5 accepted,	1 submitted.
2. Books/Book Chapters:	9	
3. Journal Papers:	11	
4. Magazine Articles:	4	
5. Peer-Reviewed Conference Papers:	72	
6. Technical reports:	32	
7. Patents:	39	

A. Recently Submitted or Accepted for Publication.

- (1) D.P. Benjamin, D.M. Lyons, John V. Monaco, Lin Yixia, “Using a Virtual World for Robot Planning,” in: *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications, SPIE Defense Security and Sensing Symposium*, Baltimore MD, April 2012.
- (2) D.M. Lyons, P. Nirmal, “Navigation of uncertain terrain by fusion of information from real and synthetic imagery,” in: *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications, SPIE Defense Security and Sensing Symposium*, Baltimore MD, April 2012.
- (3) Damian Lyons, Ron Arkin, Stephen Fox, Jiang Shu, Prem Nirmal and Munzir Zafir, “Characterizing Performance Guarantees for Multiagent, Real-Time Systems operating in Noisy and Uncertain Environments,” in: *Performance Metrics for Intelligent Systems (PERMIS’12) Workshop*, March 20-22 2012 College Park, MD.
- (4) Ronald C. Arkin, Damian Lyons, J. Shu, P. Nirmal, “Getting it Right the First Time: Predicted Performance Guarantees from the Analysis of Emergent Behavior in Autonomous and Semi-autonomous Systems,” in: *Unmanned Systems Technology XIV, SPIE Defense Security & Sensing Symposium*, Baltimore MD, April 2012.
- (5) D.M. Lyons, R.C. Arkin, S. D. Fox, P. Nirmal, J. Shu, “Designing Autonomous Robot Missions with Performance Guarantees,” To be published in: *Intelligent Robots and Systems (IROS) 2012*, Vila Moura, Algarve Portugal, Oct. 7-12th 2012.

- (6) D.M. Lyons, R.C. Arkin, P. Nirmal, S. Jiang, T-M. Liu, “A Software Tool for the Design of Critical Robot Missions with Performance Guarantees,” Submitted to: 11th Annual Conference on Systems Engineering Research (CSER 2013) March 19-22, 2013, Atlanta, Georgia.

B. Books or Book Chapters.

- (1) Lyons, D.M., *Cluster Computing for Robotics and Computer Vision*. World Scientific, 2011.
- (2) Lyons, D.M., Papadakis-Kanaris, C., Weiss, G., Werschulz, A.G., *Fundamentals of Discrete Structures. 2/E*, Pearson Learning Solutions, 2012.
- (3) Lyons, D.M. and Pelletier, D., “A Line-Scan Computer Vision Algorithm for Identifying Human Body Features” in *Gesture-Based Communication in Human-Computer Interaction, Lecture Notes in AI # 1739* (Eds. A. Braffart et al.) Springer-Verlag, 2000.
- (4) Lyons, D.M., “A Schema-Theory Approach to Specifying and Analysing the Behavior of Robotic Systems” in: *Prerational Intelligence*, (Eds. Ritter, Cruse & Dean) Kluwer Academic, Dordrecht/Boston/London 2000.
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- (6) Lyons, D.M. and Hendriks, A., Reactive Planning. *Encyclopedia of Artificial Intelligence*, 2nd Edition, Wiley & Sons, December, 1991.
- (7) Venkataraman, S. and Lyons D.M., A Task-Oriented Architecture for Dexterous Manipulation in: *Dexterous Robot Hands* (Iberall T., Venkataraman, S.T., Eds.) Springer-Verlag 1990.
- (8) Arbib, M.A., Iberall, T. and Lyons, D.M., Schemas that Integrate Vision and Touch for Hand Control, in: *Vision, Brain and Cooperative Computation* (Arbib, M.A., Hanson, A.R., Eds.), MIT Press, 1987.
- (9) Iberall, T., Lyons, D.M. Perceptual Robotics: Towards a Language for the Integration of Sensation and Perception in a Dexterous Robot Hand in: *Management and Information Systems, Volume II—Languages for Automation* (S.K. Chang, Ed.), Plenum Publishing Company, 1985.

C. Journal Papers.

- (1) Lyons, D.M., and Hsu, D.F., Method of Combining Multiple Scoring Systems for Target Tracking using Rank-Score Characteristics. *Information Fusion* 10(2), 2009
- (2) Lyons, D.M. and Murphy, T.G., Gesture Interpretation from Video Input. *Philips Research Bulletin on Systems and Software* 21, July 1997.
- (3) Lee, S., Lyons, D., Ramos, C., Troccaz, J. Guest Editorial: Special Issue on Assembly and Task Planning. *IEEE Trans. Robotics and Automation* 12(2) April 1996.
- (4) Lyons, D.M. and Hendriks, A., Planning as Incremental Adaptation of a Reactive System. *Journal of Robotics & Autonomous Systems* 14, 1995, pp.255-288.
- (5) Lyons, D.M. and Hendriks, A., Exploiting Patterns of Interaction to Achieve Reactive Behavior. Special Issue on Computational Theories of Interaction, *Artificial Intelligence* 73, 1995, pp.117-148.
- (6) Lyons, D.M., Book Review of David Chapman's Vision, Instruction, and Action Special Issue on Computational Theories of Interaction, *Artificial Intelligence*, Eds. P. Agre & S. Rosenschein, 73, 1995.
- (7) Lyons, D.M., Representing and Analyzing Action Plans as Networks of Concurrent Processes. *IEEE Transactions on Robotics and Automation* June 1993.
- (8) Lyons, D.M. and Hendriks, A., ADAPT: A Toolkit for Fast Prototyping of Embedded Software. *Philips Research Bulletin on Software & Systems* July 1993.
- (9) Hendriks, A. and Lyons, D.M., A Methodology for Creating and Adapting Reactive Systems. *IEEE Journal on Tools for AI*, 1993.
- (10) Lyons, D.M. and Arbib, M.A., A Formal Model of Computation for Sensory-based Robotics. *IEEE Transactions on Robotics and Automation* 5(3), Jun. 1989.
- (11) Arbib, M.A., Iberall, T. and Lyons, D.M., Coordinated Control Programs for Movements of the Hand. *Experimental Brain Research* #10, Springer-Verlag, 1985.

D. Magazine Articles.

- (1) Lyons, D.M., A Field of View based Camera Control Interface. *Philips Newsletter* #185 1999.
- (2) Lyons, D.M., A Camera-Based User Interface. *Philips Newsletter* #167 1996.

- (3) Gottschlich, S., Ramos, C., Lyons, D., Assembly and Task Planning: A Taxonomy. *IEEE Robotics & Automation Magazine* 1(3) Sept. 1994.
- (4) Lyons, D.M., and Hendriks, A., A Toolkit for Designing and Evaluating Discrete-Event Control Strategies. *Philips Research Newsletter* April 1992.

E. Peer-reviewed Conference Papers.

- (1) Stephen D. Fox, Damian M. Lyons, An approach to stereo-point cloud registration using image homographies. *SPIE Conference on Intelligent Robots and Computer Vision XXVII: Algorithms and Techniques*, San Francisco, CA, January 2012.
- (2) D.M. Lyons, P. Benjamin, A relaxed fusion of information from real and synthetic images to predict complex behavior. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications* at the *SPIE Defense and Security Symposium*, Orlando (Kissimmee), FL, April 2011.
- (3) Benjamin, D., Monaco, V., Lin, X., and Lyons, D., Comprehension and Prediction of Astronaut Dynamics. *IEEE Aerospace Conference*, Big Sky, Montana, March 2011.
- (4) Lyons, D., Selection and Recognition of Landmarks Using Terrain Spatiograms, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Taipei, Taiwan, October 2010.
- (5) Lyons, D., Detection and Filtering of Landmark Occlusions using Terrain Spatiograms. *IEEE Int. Conference on Robotics and Automation*, Anchorage, Alaska, May 2010.
- (6) D.M. Lyons, S. Chaudhry, P. Benjamin, A Visual Imagination Approach to Cognitive Robotics. *Symposium on Understanding the Mind and Brain*, Tucson, Arizona, May 2010.
- (7) D.M. Lyons, S. Chaudhry, Marius Agica and John Vincent Monaco, Integrating perception and problem solving to predict complex object behaviors. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications* at the *SPIE Defense and Security Symposium*, Orlando (Kissimmee), FL, April 2010.
- (8) D.P. Benjamin, D.M. Lyons, A Cognitive Approach to Classifying Behaviors. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and*

- Applications* at the *SPIE Defense and Security Symposium*, Orlando (Kissimmee), FL, April 2010.
- (9) Lyons, D.M., Chaudhry, S., and Benjamin, P., Synchronizing real and predicted synthetic video imagery for localization of a robot to a 3D environment. *SPIE Conference on Intelligent Robots and Computer Vision XXVII: Algorithms and Techniques*, San Jose, CA, January 2010.
- (10) Lyons, D.M., Sharing Landmark Information Using MOG Terrain Spatiograms. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, St Louis, MO, October 2009.
- (11) Damian M. Lyons. Tracking and sharing landmarks in a team of autonomous robots. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications* at the *SPIE Defense and Security Symposium*, March 2009, Orlando (Kissimmee), FL.
- (12) Lyons, D.M., Benjamin, P., Locating and Tracking Objects by Efficient Comparison of Real and Predicted Synthetic Video Imagery. *SPIE Conference on Intelligent Robots and Computer Vision XXVI: Algorithms and Techniques*, San Jose, CA, January 2009.
- (13) Lyons, D.M. and Hsu, D.F., Comparing CFA and Discrimination for Selecting Tracking Features. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications* at the *SPIE Defense and Security Symposium*, 18-20 March 2008, Orlando (Kissimmee), FL.
- (14) Benjamin, D.P., Lonsdale, D., and Lyons, D.M., Using Cognitive Semantics to Integrate Perception and Motion in a Behavior-Based Robot. ECSIS Symposium on Learning and Adaptive Behaviors for Robotic Systems, LAB-RS '08. Aug. 2008, Edinburgh, United Kingdom. Pp.77-82.
- (15) Lyons, D.M., Hsu, D.F., Ma, Q., and Wang, L., Combinatorial Fusion Criteria for Robot Mapping. *21st International Conference on Advanced Information Networking and Applications* (AINA 2007), May 21-23 2007, Niagara Falls Canada.
- (16) Benjamin, D., Lonsdale, and Lyons, D., A Cognitive Approach to Comprehending Human Language and Behaviors. *ACM/IEEE international conference on Human-robot interaction*, March 10-12th 2007.

- (17) Lyons, D.M., Hsu, D.F., Ma, Q., and Wang, L., Selection of fusion operations using rank-score diversity for robot mapping and localization. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications* at the *SPIE Defense and Security Symposium*, 9-13 April 2007, Orlando (Kissimmee), FL.
- (18) Lyons, D., A Novel Approach to Efficient Legged Locomotion. *10th Int. Conference on Climbing and Walking Robots*. 16-18 July 2007, Singapore.
- (19) Lyons, D.M., Isner, G.R., Evaluation of a Parallel Algorithm and Architecture for Mapping and Localization. *7th Int. Symposium on Computational Intelligence in Robotics and Automation, CIRA 2007*, Jacksonville FL June 20-23, 2007
- (20) Benjamin, D.P., Lonsdale, D., and Lyons, D.M., Embodying a Cognitive Model in a Mobile Robot, *SPIE Conference on Intelligent Robots and Computer Vision*, Boston, October, 2006.
- (21) Benjamin, D.P., Achtemichuk, T., , and Lyons, D.M., Obstacle Avoidance using Predictive Vision based on a Dynamic 3D World Model, *SPIE Conference on Intelligent Robots and Computer Vision*, Boston, October, 2006.
- (22) Hsu, D.F., and Lyons, D.M., Combinatorial Fusion Criteria for Real-Time Tracking. *9th Int. Conf on Information Fusion 2006*, July 10-13 2006, Florence, Italy.
- (23) Hsu, D.F., Lyons, D.M., and Ai., J., Combining Multiple Scoring Systems For Video Target Tracking Based on Rank-Score Function Variation, *38th Symposium on the interface of statistics, computing science, and applications (Interface 2006)*, Pasadena CA, May 2006.
- (24) Benjamin, D.P., Lonsdale, D., and Lyons, D.M., Developing a Cognitive Architecture to be Embedded in the Physical World, *Behavior Representation in Modeling and Simulation (BRIMS206)*, Baltimore, May, 2006.
- (25) Hsu, D.F., Lyons, D.M., and Ai, J., Feature selection for real-time tracking. *Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2006* at the *SPIE Defense and Security Symposium Symposium*, 17-21 April 2006, Orlando (Kissimmee), FL.
- (26) Hsu, D.F., Lyons, D.M., and Ai, J., Combinatorial Fusion Criteria for Real-Time Tracking. *20th International Conference on Advanced Information Networking and Applications (AINA 2006)*, 18-20 April 2006, Vienna, Austria.

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- (28) Lyons, D.M., Hsu, D.F., Rank Based Multisensory Fusion in Multitarget Video Tracking. *IEEE Int. Conf. on Advanced Video & Signal-Based Surveillance (AVSS 2005)* July 2005, Como Italy.
- (29) Lyons, D., and Pamnany, K., Rotational Legged Locomotion. *IEEE Int. Conf. on Advanced Robotics*, July 2005, Seattle, WA.
- (30) Hsu, D.F., Lyons, D.M., A Dynamic Pruning Strategy for Real-Time Tracking, *IEEE International Conference on Advanced Information Networking and Applications*, March 2005, Taipei Taiwan.
- (31) Drysdale, J., Lyons, D., Learning Image-Based landmarks for Wayfinding using Neural Networks. *Artificial Neural Networks in Engineering*, March 2004, St. Louis MO.
- (32) Benjamin, D.P., Lonsdale, D., Lyons, D., Designing a Robot Cognitive Architecture with Concurrency and Active Perception. *AAAI Fall Symposium on Cognitive Science and Robotics*, Oct. 2004, Washington DC.
- (33) Benjamin, D.P., Lonsdale, D., Lyons, D., Integrating Perception, Language and Problem Solving in a Cognitive Agent for a Mobile Robot. *Third International Joint Conference on Intelligent Agents and Multiagent Systems*, July 2004, NYC, NY.
- (34) Benjamin, D.P., Lyons, D., Lonsdale, D., ADAPT: A Cognitive Architecture for Robotics. *2004 International Conference on Cognitive Modeling*, Pittsburgh PA July 2004.
- (35) Lyons, D.M., Arkin, R.A., Towards Performance Guarantees for Emergent Behavior, *IEEE International Conference on Robotics and Automation*, New Orleans LA, April 2004.
- (36) Hsu, D.F., Lyons, D.M., Usandivaras, C., Montero, F., RAF: A Dynamic and Efficient Approach to Fusion for Multitarget Tracking in CCTV Surveillance, *IEEE Int. Conf. on Multisensor Fusion and Integration for Intelligent Systems*, July 29-Aug.1, 2003, Tokyo, Japan.

- (37) Lyons, D.M., Discrete-Event Modeling of Misrecognition in PTZ Tracking. *IEEE Int. Conf. on Advanced Video & Signal-Based Surveillance, July 21-22, 2003, Miami Beach FL.*
- (38) Lyons, D.M., Hsu, D.F., Usandivaras, C., Montero, F., Experimental Results from Using a Rank and Fuse approach for Multi-Target Tracking in CCTV Surveillance. *IEEE Intr. Conf. on Advanced Video & Signal-Based Surveillance, July 21-22, 2003, Miami Beach FL.*
- (39) Brodsky, T.; Cohen, R.; Cohen-Solal, E.; Gutta, S.; Lyons, D.; Philomin, V.; Trajkovic, M. Visual surveillance in retail stores and in the home. Invited paper. *2nd European Workshop on Advanced Video Based Surveillance Systems, 9/4/2001, Kingston upon Thames, London, UK*
- (40) Gutchess, D., Trajkovic, Cohen-Solal, E., M., Lyons, D., Jain, A., A Background Model Initialization Algorithm for Video Surveillance, *Int. Conf. on Comp. Vision 2001.*
- (41) Lee, M-S., Weinshall, D., Colmenarez, A., Cohen-Solal, E., Lyons, D., Identifying a 3-D pointing target with 2-D homography and line intersection *Int. Conf. on Comp. Vision 2001.*
- (42) Lyons, D.M., Brodsky, T., Cohen-Solal, E., and Elgammal, A., Video Content Analysis for Surveillance Applications, *Philips Digital Video Technologies Workshop 2000, Briarcliff NY.*
- (43) Lyons, D.M. et al., Automated CCTV Surveillance using Computer Vision Technology, *Philips DSP Conference 1999, Eindhoven NL.*
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- (47) Lyons, D.M. and Hendriks, A., Testing Adaptive Planning, *2nd International Conference on AI Planning Systems*, June 1994, Chicago IL.
- (48) Lyons, D.M. and Hendriks, A.J., Adaptive Planning: An Approach that Views Errors as Assumption Failures, *AAAI Spring Symposium on Detecting and Resolving Errors in Manufacturing Systems* March 1994.
- (49) Lyons, D.M. and Hendriks, A., Planning by Adaptation: Experimental Results, *IEEE Int. Conf. on Rob. & Aut.*, San Diego CA, May 1994.
- (50) Lyons, D.M., Building and Analyzing the Behavior of Autonomous Robot Systems. *Center for Interdisciplinary Research (ZiF) Conf. on Prerational Intelligence*, Univ. of Bielefeld, Germany, November 1993.
- (51) Lyons, D.M. and Hendriks, A., Safely Adapting a Hierarchical Reactive System. *SPIE Intelligent Robots and Computer Vision XII* September 1993.
- (52) Murphy, T., Lyons, D.M. and Hendriks, A., Stable Grasping with a Multi-Fingered Robot Hand: A Behavior-Based Approach, *Intelligent Robots and Systems (IROS)* Japan 1993.
- (53) Murphy, T., Lyons, D.M. and Hendriks, A., Visually Guided Multi-Fingered Grasping as Defined by Schemas and a Reactive System, *Workshop on Neural Architectures and Distributed AI, Los Angeles CA*, 1993.
- (54) Lyons, D.M. and Hendriks, A., A Practical Approach to Integrating Reaction and Deliberation. *First AI Conference on Planning Systems*, Univ. of Maryland, College Park MD, 1992.
- (55) Lyons, D.M. and Hendriks, A., Planning for Reactive Robot Behavior. *IEEE Int. Conf. on Robotics and Automation* Nice, France 1992.
- (56) Lyons, D.M. and Hendriks, A.J., Achieving Robustness by Casting Planning as Adaptation of a Reactive System. *IEEE Int. Conf. on Robotics and Automation*, Sacramento CA, April 1991.
- (57) Lyons, D.M. and Hendriks, A. Planning and Acting in Real-Time *13th IMACS World Congress on Comp. and Applied Math.* Trinity College, Dublin, July 1991.

- (58) Lyons, D.M. and Hendriks, A., Implementing an Integrated Approach to Planning and Reaction. *SPIE Conf. on Intelligent Robots and Computer Vision: Algorithms and Techniques*. Boston MA, November 1991.
- (59) Lyons, D.M. and Allton, J.H., Achieving a Balance between Teleoperation and Autonomy in Specifying Plans for a Planetary Rover, *SPIE Symposium on Advances in Intelligent Systems; Cooperative Intelligent Robotics in Space*, Boston, MA, Nov. 1990.
- (60) Gopinath, P., Lyons, D.M. and Mehta, S., Representation and Execution Support for Reliable Robot Applications. *9th Symp. on Reliable Distributed Systems*, Huntsville, Alabama, Oct. 1990.
- (61) Lyons, D.M., Mehta, S. and Gopinath, P., Robust Representation and Execution of Robot Plans, *EuroMicro Real-Time Systems Workshop*, Horsholm, Denmark, May 28-30th, 1990.
- (62) Lyons, D.M., RS: A Formal Model for Reactive Robot Plans, *2nd RPI Int. Conf. on Computer Integrated Manufacturing* Troy, NY, May 21--23, 1990.
- (63) Lyons, D.M., Pelavin, R., Hendriks, A., Benjamin, P. Task Planning using a Formal Model for Reactive Robot Plans. *AAAI Spring Symposium on Planning in Uncertain and Dynamic Environments*. Stanford CA, Mar. 27-29th, 1990.
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- (65) Lyons, D.M. and Mehta, S., A Distributed Computing Environment for the Multiple Robot Domain, *Fourth International Conference on CAD, CAM, Robotics and Factories of the Future*, New Delhi, India, Dec. 19--22nd, 1989.
- (66) Lyons, D.M., Vijaykumar, R. and Venkataraman, S., A Representation for Error Detection and Recovery in Robot Task Plans. *SPIE Symposium on Advances in Intelligent Robotic Systems; Intelligent Robots and Computer Vision* Philadelphia PA, Nov. 7-8th, 1989.
- (67) Lyons, D.M., On-Line Allocation of Robot Resources to Task Plans. *SPIE Symposium on Advances in Intelligent Robotics; Expert Robots for Industrial Use*, Nov. 1988.

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- (69) Lyons, D.M., Tagged Potential Fields: An Approach to the Specification of Complex Manipulator Configurations. *IEEE International Conference on Robotics and Automation*, San Francisco CA, Apr. 7-11th, 1986.
- (70) Lyons, D.M. and Arbib, M.A., A Task-Level Model of Distributed Computation for the Sensory-Based Control of Complex Manipulators. *IFAC Symposium on Robot Control*, Barcelona, Spain, Nov. 6-8th, 1985.
- (71) K. Ramamritham, D. Lyons, G. Pocock and M.A. Arbib, Towards Distributed Robot Control, *IFAC Symposium on Robot Control*, Barcelona, Spain, Nov 1985, pp. 107-112.
- (72) Lyons, D.M., A Simple Set of Grasps for a Dexterous Hand, *IEEE International Conference on Robotics and Automation*, St. Louis, Missouri, Mar. 25-28th, 1985.

F. Technical Reports.

- (1) Brodsky, T., Cohen, R., Gutta, G., Lyons, D., Retail Applications of the Video Content Analysis Module. Philips TN-2000-021 2000.
- (2) Lyons, D., Trajkovic, M., Briarcliff Intruder Tracking Engine V2.41 User Manual, Philips TSR-2000-011 2000.
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- (4) Lyons, D., Brodsky, T., Cohen-Solal, E., and Gutta, S., Residential Video Content Analysis Requirements Document, Philips TSR-2000-010, 2000.
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- (7) Lyons, D.M., Murphy, T.F., and Pelletier, D.L. Interpretation of Arm Pointing, Philips Research Tech. Note TN-97-041 1997.
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- (9) Lyons, D.M. A Computer Vision System for Extracting Feature Information from Video Camera Images of People, Philips Research Tech. Report TR-97-008 1997.
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- (12) Lyons, D.M., Murphy, T.G. Infowall with Camera-Based Interface, Philips Research Tech. Note TN-96-032 1996.
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- (20) Lyons, D.M., Hendriks, A. J. and Mehta, S. A Study of Adaptive Approaches to Control of the MCM-VIII. Philips Research Tech. Report TR-90-026 Sept. 1990.
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- (25) Lyons, D.M., A Novel Approach to High-Level Robot Programming. (Updated) Philips Research Tech. Note TN-87-039, April 1987.
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- (28) Lyons, D.M., Implementing a Distributed Control Environment for Task-Oriented Robot Control Philips Research Tech. Note TN-87-054, April 1987.
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G. Patents (Inventor/Co-Inventor); US(15), EP (20) and WO (4) patents

- (1) Computer Software to Optimize Building Lighting Energy Consumption; *US pat # 5,812,422. EP # 0,791,280*, 1998.
- (2) System and Method for Navigation through Virtual Reality using Camera-based Gesture Inputs; *US pat # 6,195,104. EP # 0,976,106*, 2001.
- (3) Motion-Based Command Generation Technology; *US pat # 6,176,782*, 2001.
- (4) A Vacuum Cleaner with Obstacle Avoidance; *US pat #6,226,830; EP # 0,938,273* 2001.

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