Abstract

In this work, an interface between Matlab, a high level matrix oriented programming language, and the Khepera, miniature, modular experimental robot platform was developed. This interface allowed learning control algorithms to be prototyped and tested quickly and easily on a real robot with minimal effort being invested in the development of the robot or learning the robot programming language. This Matlab/Khepera interface was then used in conjunction with a Behaviour Analysis and Training (BAT) methodology to develop a learning algorithm for a light approaching/obstacle avoidance task. This learning task provided a validation of the methodology and of the interface.

The learning architecture of the control algorithm used for the light approaching/obstacle avoidance task was based on Elman Simple Recurrent Networks trained using Complementary Reinforcement Back-Propagation (CRBP). It was determined that the Matlab-Khepera interface was very effective for developing and simulating the control algorithms within the Matlab environment as well as implementing the algorithms on the Khepera robot in real time. However, the limited sensing capabilities of the Khepera base unit (without additional hubs) caused the full application of the Behaviour Analysis and Training Methodology to become difficult and restricted the application of hierarchical control structures in building more intelligent behaviour. Finally, it was determined that training with CRBP can be speeded up by the application of an exploration rule based on a Gaussian distribution of random numbers instead of a uniform distribution.

Dedication

You know, almost everyone dedicates their work to their spouse. I used to wonder why that was.

Then one day, I found out.

We went Christmas shopping. I spent five hours in a mall with my wife (and six billion other people) and I spent the whole time staring inward at an imaginary black-board trying to figure out the current week's problem with my robot.

I had a hard time even remembering what mall we went to on cross-examination (and I drove).

I would like to dedicate this work to my wife Sharon who received an undue foretaste of life with me when I'm 90. I now know that she'll drag the "mumbling vegetable" to the mall every now and then for some fresh air and a walk.

Acknowledgements

I would like to acknowledge Dr. J. Wilson for his assistance in this endeavor.

I would also like to recognize the following people/entities:

- HAL 9000: who germinated the seed that grew into this work. Compared to HAL, my robot is as dumb as a rock but at least it won't try to kill me. Happy birthday HAL.

- My appendix. Enya. PEZ. Pookie, Lexus, and Tish. The fish. The Simpsons. COPS. Tim Hortons.

- The Internet: it provided me with an abundance of information, feedback, *research papers*, and games. I would also like to recognize the people on the internet with whom I have conversed but never actually met.

- The techs, Pierre Adam, and Kim. Not for the technical support, but rather for listening to my ramblings about how to micromanage a farm.

- Last, but certainly not least, I would like to thank my friend Eric Deoliviera who rounded my post-graduate experience in all aspects non-acedemic. He shamed me into going to the gym ("the House Of Pain") and forced me get a yellow belt in Karate. He would certainly make a good demon lord of hell.

Vita

Name:	Richard Gary Goyette
Place and Date of Birth:	Timmins, Ontario, 08 February 1968
Education:	Royal Military College of Canada 1995-1997
	Royal Military College of Canada 1987-1991. Awarded Bachelor of Engineering (Electrical) May 1991.
Experience:	Post Graduate Student, Royal Military College of Canada, 1995-1997
	Secure Systems Integration and Management, Directorate of Intelligence and Security Operations Automation, 1992-1995
	Trainee, Canadian Forces School of Communications and Electronics, 1991-1992

Table of Contents

List of Figures

List of Tables