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- Completed development of the UAV simulator and simulation scenarios in the breve simulation environment, in conjunction with the University of Massachusetts DARPA TASK group (Jensen et al.).
- Used the PushGP genetic programming system to evolve high performance UAV surveillance strategies that out-performed human-designed strategies. Prepared demo materials demonstrating this performance for August DARPA demos.
- Published a book called *Automatic Quantum Computer Programming: A Genetic Programming Approach* by Lee Spector, Kluwer Academic Publishers, 2004. More information is available from <http://hampshire.edu/lspector/aqcp/>. This book includes descriptions of work conducted as part of this effort.
- The PI co-organized the AAAI 2004 Fall Symposium on Artificial Multi-Agent Learning, which will take place this coming Fall.
- Developed and implemented several major enhancements to the Push programming language for evolutionary computation, resulting in higher problem-solving potential for genetic programming systems such as PushGP. See Spector, L., C. Perry, J. Klein, and M. Keijzer. 2004. Push 3.0 Programming Language Description. <http://hampshire.edu/lspector/push3-description.html>.
- Developed a C++ implementation of the QGAME Quantum Gate and Measurement Emulator. In conjunction with the C++ implementation of PushGP this supports high performance automatic quantum computer programming by means of genetic programming. See <http://hampshire.edu/lspector/qgame.html>.
- Developed several major enhancements to the breve simulation environment, version 2.0 of which will soon be distributed. Among the many new features (several of which were critical for the UAV simulation for the DARPA TASK demo) is a new ability for users to write breve simulations in any programming language. This will broaden the applicability of the technology.
- The PI served as track chair for the genetic programming track of the Genetic and Evolutionary Computation Conference (GECCO-2004) and as co-editor of the proceedings: Deb, K., R. Poli, W. Banzhaf, H-G Beyer, E. Burke, P. Darwen, D. Dasgupta, D. Floreano, J. Foster, M. Harman, O. Holland, P. Lanzi, L. Spector, A. Tettamanzi, D. Thierens and A. Tyrrell, editors. 2004. *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2004*. Lecture Notes in Computer Science, Vol. 3102-3103, Springer-Verlag.
- Published work on coevolution of strategies for teams of agents in complex, 3D environments: Crawford-Marks, R., L. Spector, and J. Klein. 2004. Virtual Witches and Warlocks: A Quidditch Simulator and Quidditch-Playing Teams Coevolved via Genetic Programming. In *Late-Breaking Papers of GECCO-2004, the Genetic and Evolutionary Computation Conference*. Published by the International Society for Genetic and Evolutionary Computation. Paper available from: http://hampshire.edu/lspector/pubs/virtual_witches_and_warlocks.pdf. Additional information available from: <http://hamp.hampshire.edu/~rpc01/vww.html>. Additional movies at: <http://hampshire.edu/lspector/quidditch-movies/>.
- Won "best paper" in the "AAAA" track at the 2003 Genetic and Evolutionary Computation Conference (GECCO-2003) for "Emergence of Collective Behavior in Evolving Populations of Flying Agents," by Lee Spector, Jon Klein, Chris Perry, and Mark Feinstein. URL: <http://hampshire.edu/lspector/gecco2003-collective.html>. This paper demonstrates the emergence of collective behavior in two versions of the SwarmEvolve system.
- A journal article expanding the award-winning conference paper, mentioned in the item above, has been accepted for publication in *Genetic Programming and Evolvable Machines* (a Kluwer journal).
- Completed a paper on "Tags and the Evolution of Cooperation in Complex Environments" that has

- been accepted for publication in the AAI 2004 Fall Symposium on Artificial Multi-Agent Learning.
- The PI received a "Gold Medal" prize in the GECCO-2004 Human-Competitive Results contest. Additional information is available at: <http://www.genetic-programming.org/gecco2004hc.html>.
 - The PI was elected a Fellow of the International Society for Genetic and Evolutionary Computation. A press release is available at: <http://hampshire.edu/lspector/human-competitive.pdf>.
 - The PI was re-elected to the Executive Board of the International Society for Genetic and Evolutionary Computation.

revised tech transition:

The Push interpreter and the PushGP and Pushpop genetic programming systems, along with the QGAME quantum computer simulator have been made available by the PI (Lee Spector, lspector@hampshire.edu). The BREVE simulation environment is also freely available on the web, as is source code for several of the other systems developed in this effort (see the project web page). All developed technologies will be described in publications stemming from the project.