

# **Model-based Artificial Life Systems: Card Game Player Example**

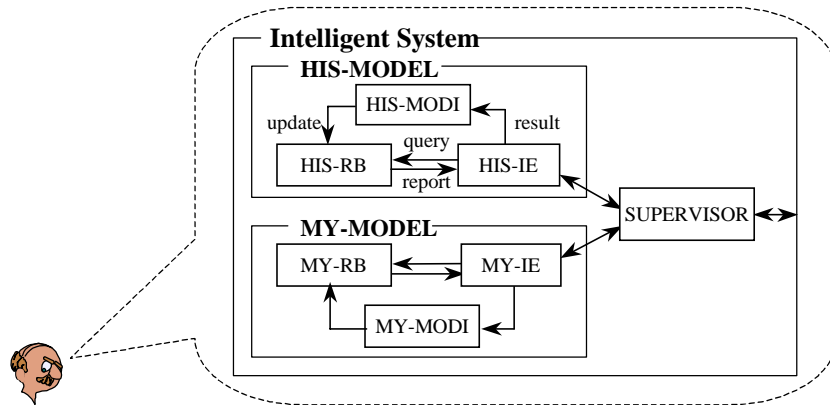
Jong-Keun Lee, Jang-Se Lee, and Sung-Do Chi  
Intelligent Systems Research Lab.  
Department of Computer Engineering  
Hangkong University  
200-1, Hwajeon-dong, Dukyang-ku, Koyang-si  
Kyonggi-do, Korea  
Tel : 82-2-3158-4866  
Fax : 82-2-3158-6748  
E-mail : leejk@mail.hangkong.ac.kr

**Keywords:** Evolutionary Intelligent Systems, Artificial Life, Genetic Algorithm, Endomorphic Modeling, SES/MB Framework, and Discrete Event Simulation

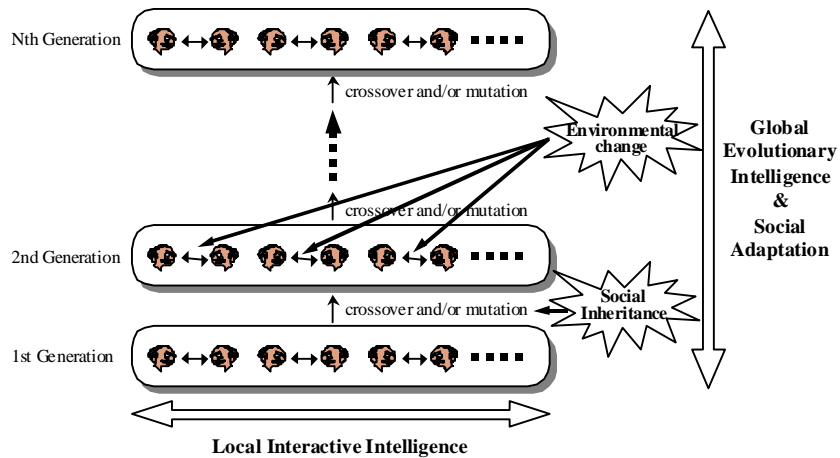
## **Extended Abstract**

The major objectives of this research is to build model-based artificial life systems that can support an individual learning, evolutionary learning, and social adaptation. To do this we have employed the extended endomorphic modeling and evolutionary modeling techniques. Figure1 represents an overview of our approach taken. The design of each intelligent individual system is accomplished by adopting the extended endomorphic modeling methodology proposed by Chi and Kim. In this approach, the intelligent system has not only other model (HIS-MODEL) but also self model (MY-MODEL), so that it can utilize both knowledge (i.e., HIS-MODEL and MY-MODEL) to deal with its world intelligently. Each model again consists of a knowledge base (HIS-RB and MY-RB), an inference engine (HIS-IE and MY-IE), and a knowledge base modifier (HIS-MODI and MY-MODI) for supporting learning capabilities. The inductive reasoning and adaptive expert system techniques are adopted for learning algorithms of other and my model, respectively. On the basis of such design methodology for intelligent individual systems, the population dynamic system of intelligent individuals can be developed so that the individual local learning and evolutionary global learning can be both accomplished as shown in Figure1. Such artificial life systems based on the population dynamics has been demonstrated the social adaptation according to their environmental changes. Our approach is compared with conventional intelligent and/or artificial life systems approaches in that (i) individual and evolutionary

learning algorithms are coherently integrated, (ii) the modeling and simulation methodology for artificial life systems is proposed. Detailed design methodology for the model-based artificial life systems will be given in our full paper and various simulation tests performed on the card game player example will demonstrate our techniques.



(a) Individual System



(b) Population System

Figure1. Model-based Artificial life Systems Overview

## REFERENCES

- [1] B.P. Zeigler, *Multifaceted Modelling and Discrete Event Simulation*, Academic Press, 1984.
- [2] B.P. Zeigler, *Object-oriented Simulation with Hierarchical, Modular Models*, Academic press, 1990.
- [3] S.D. Chi, *Modelling and Simulation for High Autonomy Systems*, Ph.D.Dissertation, Univ. of Arizona, 1991.
- [4] S.D. Chi, Y. K. Kim, "Model-based Design for Intelligent Systems : Intelligent Card Game Player", *Proc. IEEE on System, Man, and Cybernetics*, Vancouver, Canada, Nov., 1995.
- [5] S.D. Chi, J. K. Lee, J. S. Lee, "Model-based Design for Autonomous Defense System", *Proc. Military, Government and Aerospace Simulation*, Vol. 30, No.4, 1998.
- [6] J.P. Müller, *The Design of Intelligent Agents*, Springer, 1996.
- [7] A.M. Wildberger, "AI & Simulation", *Simulation*, 1996.
- [8] D.E. Goldberg, *Genetic Algorithm in Search, Optimization, and Machine Learning*, Addison-Wesley, 1989.
- [9] M..Srinivas, L.M. Patnaik, "Genetic Algorithms : A Survey", *IEEE Computer*, 1994
- [10] J.L. Ribero Filho, P.C. Treleavan, and C. Alippi, "Genetic-Algorithm programming Environments", *IEEE Computer*, 1994.
- [11] E.W. Bonabeau, G. Theraulaz, "Why do we need artificial life", *Artificial Life*, MIT Press, 1997.
- [12] M. Mitchell, S. Forrest, "Genetic Algorithms and Artificial Life", *Artificial Life*, MIT Press, 1997.
- [13] J.S. Lee, J.K. Lee, S.D. Chi, "Design of Evolutionary Intelligent Systems: Card Game Player Example", *Proc. of the IASTED International Conf. ASC*, pp567-571, Hawaii, USA, Aug., 1999.