Ant Colony Systems Toolbox for Non-Combinatorial Problem Solving

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Abstract --- We are developing new computation, simulation and data analysis methods through the unique exploration of video and auditory scene analysis, via Ant Colony System (ACS) engineering. Our attempt to create a full function, integrated Memory Augmented Scene Analysis (MASA) system using semi-autonomous agents takes advantage of four time/computation saving innovations: 1) context-reconfigurable hardware, 2) fast pre-processing algorithms, 3) foveated retinas, and 4) memory augmented scene reconstruction. While both the ACS MASA system and general scene analysis determine what is seen, the MASA differentiates itself by using what it has learned from the past during its analysis of the scene through use of a cognitive map. The major feature of this system is that the solution algorithm set is evolving due to the use of genetic algorithms combined with ACS, affording the algorithm environment specific malleability. The expected result will be an evolvable ACS providing solution sets for non-combinatorial problems implemented in software, including viable hardware implementations on the FPGA. This project significantly expands the knowledge base of ACS applications beyond combinatorial optimizations. Thus far we have designed ACS ant movement algorithms for ants on digital habitats that simulate human attention by mimicking human foveal movements. Tools currently in the toolbox include ant movement routines (based on random walks, cellular automata, and pheromone deposition), Pseudo-Random Number Generation, vision algorithms (segmentation, area estimation, edge detection, and feature extraction), auditory algorithms (feature extraction), and data mining (classification and clustering).