Towards Nature-Inspired Self Management of Problem Solving Strategies

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Introduction

The fact that highly complex behavior may arise from the cooperation of many simple entities/processes motivated the design of high-level optimization strategies from low-level interaction of simpler algorithms. Within the context of the Task Force on "Nature Inspired Cooperative Strategies for Optimization" leaded by one of us, we are studying which cooperation mechanisms are best suited to be embedded in such strategies.

Some of the preliminary results we already have, clearly indicate that cooperation/collaboration mechanisms in Nature are not performed in a "Boolean" way, but rather it is graded, permissive and multi-form. This is why when we seek inspiration from Nature to model cooperative strategies, it makes perfect sense to approach it from the fuzzy sets & systems side.

From the problem solving point of view, is seems clear that it makes no sense to focus on large-size, well defined single objective problems, because the field of meta heuristics (some of them, also nature-inspired) is plenty of strategies that can provide excellent solutions.

In turn, it is more interesting to focus on large, ill-defined problems, with multiple objectives, with time-varying cost functions, or uncertainty in the values of the variables, or moreover, with ill-defined cost functions.

Rigid, static systems that can not adapt to changes in the environment, problem definition, user requirements, are clearly not suitable to run in such scenarios. Instead, we need systems that can adapt, repair, reconfigure, etc. by themselves as the environment varies.

Cooperative strategies seem to be adequate toolboxes to implement such systems, provided those are enhanced with some additional self-managed capabilities. We may require the strategies to be self

- ***adaptive***: the system dynamically reacts to changes in the environment and adapts its behavior to achieve some predefined level of quality of service.

- ***configuring***: refers to the ability to modify the interaction among components. It is usually achievable using high level policies indicating what the system must do and not how the system reaches such goals.

- ***healing***: the system is able to find, diagnose and react to system malfunctions. To do that in an automatic way, is a pre-condition to have some notion of expected system behavior

- ***optimizing***: the system monitors and autonomously optimizes the system resources.

- ***organizing*** : refers to mechanisms that allow the system' components to configure the interactions among them, while guaranteeing the architectural design constraints.

Such abilities are easily found in Nature. For example, the immune system providing self-healing and self-protection; flocks of birds, fishes, etc, providing examples of self organization; proteins are paradigmatic cases of self-assembly systems; the body is able to self-repair from small hurts, etc

Assuming the broad context provided by Soft Computing, the idea is to explore research and development topics of self-managed strategies for problem solving looking for inspiration from areas such as Genetic Programming and Algorithms, Immunocomputing, Social Insects Intelligence (Swarm ants, termites, bees), Multi-objective Optimization, etc..

Acknowledgments

This work was supported in part by project TIN2005-08404-C04-01 from the Spanish Ministry of Science and Technology and TIC-00129 (MINAS) from Andalusian Council.

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