Chapter 7
Autonomic Computing for a Complex Problem of Experimental Physics

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ABSTRACT

Standard experimental data analysis is based mainly on conventional, deterministic inference. The complexity of modern physics problems has become so large that new ideas in the field are received with the highest of appreciation. In this paper, the author has analyzed the problem of contemporary high-energy physics concerning the estimation of some parameters of the observed complex phenomenon. This article confronts the Natural and Artificial Networks performance with the standard statistical method of the data analysis and minimization. The general concept of the relations between CI and standard (external) classical and modern informatics was realized and studied by utilizing of Natural Neural Networks (NNN), Artificial Neural Networks (ANN) and MINUIT minimization package from CERN. The idea of Autonomic Computing was followed by using brains of high school students involved in the Roland Maze Project. Some preliminary results of the comparison are given and discussed.

INTRODUCTION

The analysis of the surrounding physical reality, for last at least three thousand years, as we know it, follow the line of building simplified models and solving problems using specific tools developed with applied approximations making them easy or relatively easy to maintain. The unquestioned successes of such, scientific, way of thinking allow us to create so-called civilization. However, this method, which we can call (Wang, 2007b) the Imperative Computing have limitations. Some problems can not be treated this way, at least at present. There is a belief that, e.g., mathematical

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tools needed to solve some problems in quantum field theory or hydro- or thermodynamic will be developed in the future. Some see a hope in ‘analog’ quantum computations. However, at the moment there are much common problems where the usual methods of ‘standard analysis’ sometimes fail (the general problem of `pattern’ recognition is the perfect example). Quite recently the Cognitive Informatics (CI) theory shows other possible solution. It is the Autonomic Computations (AC). By definition (Wang, 2007b) the AC is not a passive system and uses among others the inference-driven mechanisms to get a (nondeterministic!) result. The realization is not obvious, but we propose that usage of untrained children brains just follows a general concept described in the Layered Reference Model of the Brain (Wang et al., 2006). The word ‘untrained’ here is important. The preliminary comparison with the ‘professional’ brain is discussed in the present work. The role of *a prior* knowledge is expected and seen, but it seems to be surprisingly small.

We would like to discuss here a particular problem of the describing of the data registered by some cosmic ray physics experimental device. The standard analysis involves extensive Monte Carlo studies (and there are still discrepancies between different groups of experimentalists and theoreticians). Situations reach the level described very well in the web ‘intro’ to IBM Autonomic Computing Manifesto (IBM, 2001): “Computing is too hard. It’s time we stop our preoccupation with faster and more powerful and start making them smarter.”

Our statement is that some extremely complex problems can be solved not only qualitatively but also quantitatively on the same level as this of the standard statistical method precision not only by ANN trained for this particular problem but also with the (over-sized, redundant) NNN using their ‘natural’ meta and higher cognitive functions acquired in the past, as a part of natural intelligent (NI) system category of conscious life functions known as the NI applications layers not obviously (obviously not) related to the particular problem.

Methods of the analyzing the NNN and ANN performance is shown and some first results are given in this paper. We would like to emphasize here that the present analysis is the interesting particular example of the domination of Artificial Intelligence by the Natural Intelligence (Wang, 2007a).

The Physical Problem and The Standard, Imperative Computing, Solution

The ultra high-energy cosmic ray particles, its origin and nature are one of the most intriguing questions on general interest among the physicists. The phenomenon of arriving from the cosmos of the elementary particle with energy of about 50 J is very rare and thus hard to investigate experimentally. Fortunately during the passage through the Earth atmosphere the cascade of smaller energy secondary particles is created and eventually the surface is momentarily bombarded by billions of particles spread over the area of squared kilometers. The experimental setups for registrations of such events consists of several to several thousand detectors separated by hundreds of meters to few kilometers equipped with the triggering and recording devices.

Such arrays sample the mentioned showers of particles in not very big number of points and this is the only information we have about the event. (We do not discuss here the experiments recording the fluorescent light which is the distinct and complementary technique of study such phenomena.) Each detector of the surface array registers actual number of particles passing the detector giving the information about particle density at the detector position. It is additionally smoothed by the physics of the detection process and electronic noises of different kinds. The transition from recorded digits to the physics in question is to estimate the shape of the distribution of cascade particles on the ground. The limited information allows us only to get the precise

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