International Journal of Innovative Computing, Information and Control
Volume **6**, Number **3(A)**, March **2010**
 ISSN 1349-4198
pp. 1005–1022

A DISTRIBUTED AUTONOMOUS NEURO-GEN LEARNING ENGINE AND ITS APPLICATION TO THE LATTICE ANALYSIS OF CUBIC STRUCTURE IDENTIFICATION PROBLEM

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Received September 2008; revised February 2009

Abstract. *In this paper, we introduce a new machine learning tool: a distributed autonomous neuro-gen learning engine (DANGLE). The tool's motivation is to solve the lattice analysis of cubic structure identification problem. Our engine is also indirectly designed to solve common problems in existing neurogenetic implementations. The proposed DANGLE consists of a gene regulatory engine (GRE) and a high performance distributed adaptive neural network (DANN). Our experiments show that DANGLE performs better than EFuNN and is a powerful tool for lattice analysis of cubic structure identification.*
Keywords: X-ray diffraction, Cubic structure identification, Neurogenetic, Distributed adaptive neural network, Gene regulatory engine

1. **Introduction.** Since the eighteenth century, crystallography has been one of the most challenging research fields in physics. It is the branch of science that deals with the geometric forms of crystalline material. The importance of crystallography has helped to advance research in different fields such as geophysics, material sciences, and solid-state physics. It has also helped in the development of all materials areas, including metals and alloys, ceramics, glasses, polymers, and drug design. In addition, it also has a vital role in the progress of fundamental chemistry, mineralogy, geology and in the understanding of the dynamics and processes of living systems [1]. As technology advances, especially with the invention of X-ray devices, crystallography research has evolved. The use of the X-ray diffraction (XRD) method [2] to analyze the composition of crystalline material has become the standard in crystallography research, and it has been applied in several different real world applications: for example, forensic analysis of material samples from crime scenes [3], identifying mineralogical compositions in the geothermal fields [4], and applications in conservation science and archaeometry [5].

One of the most important tasks in applied crystallography research is lattice analysis to identify the crystalline material's cubic structure [6-8]. Lattice analysis requires in-depth X-ray diffraction data interpretation, and this is a dynamic and laborious task. The main reason for this is that, besides the fact that the resulted X-ray diffraction data form a very large and complex dataset, the crystalline materials are mainly obtained from the earth and their shape and structure may change over time due to natural evolution,