Current Trends in Artificial Intelligence (AI) Application to Oil and Gas Industry

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1 Introduction

In recent years, artificial intelligence (AI), in its many integrated flavors from neural networks to genetic optimization to fuzzy logic, has made solid steps toward becoming more accepted in the mainstream of the oil and gas industry.

On the basis of recent developments in the field of Oil & Gas upstream, it is becoming clear that petroleum industry has realized the immense potential offered by intelligent systems. Moreover, with the advent of new sensors that are permanently placed in the wellbore, very large amounts of data that carry important and vital information are now available.

To make the most of these innovative hardware tools, an operator intervention is required to handle the software to process the data in real time. Intelligent systems are the only viable techniques capable of bringing real-time analysis and decision-making power to the new hardware.

An integrated, intelligent software tool must have several

important attributes, such as the ability to integrate hard (statistical) and soft (intelligent) computing and to integrate several AI techniques. The most used techniques in the Oil and Gas sector are:

- **Genetic Algorithm (GA)**, inspired by the biological evolution of species in natural environment, consists of a stochastic algorithm in which three key parameters must be defined:
    1. Chromosomes, or better, vectors constituted by a fixed number of parameters (genes).
    2. A collection of chromosomes called genotype, which represents the individuals of a population.
    3. The operations of selection, mutation, and crossover to produce a population from one generation (parents) to the next (offspring).
- **Fuzzy Logic (FL)** is a mathematical tool able to covert crisp (discrete) information as input and to predict the correspondent crisp outlet by means of a knowledge base (database) and a specific reasoning mechanism. To achieve such goal, the crisp information is firstly converted into a continuous (*fuzzy*) form, secondly processed by an inference engine and at least re-converted to a crisp form.
- **Artificial neural network (ANN)** is constituted by a large number simple processing units, characterized by a state of activation, which communicate between them by sending signals of different weight. The overall interaction of the units produces, together with an external input, a processed output. The latter is also responsible of changing the state of activation of the units themselves.

The techniques described above have been adopted in the Oil and Gas field since 1989. Relatively to O&G industry, Figure 1 shows the number of applications of AI.

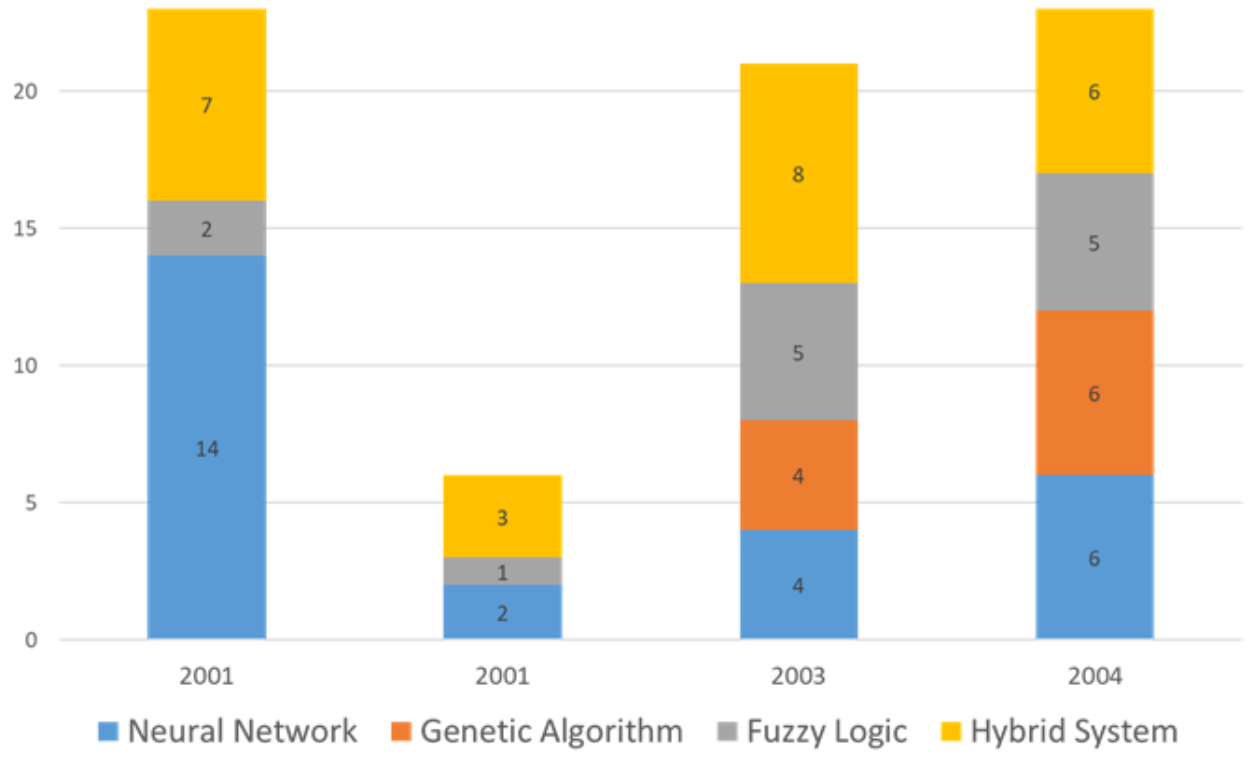

Figure 1 Artificial intelligence (AI) applications in the Oil and Gas industry during the years.

In the following sections some of the application of AI in the O&G sector will be analyzed with a particular focus on the *Drilling operation* (Exploration & Production).

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