

A Study on Method of Development of Chemical Process Specific Artificial Intelligence for chemical industries

Shah Krunal Rajendrakumar¹

¹ M.E. Computer Aided Process Design (Chemical Engineering), Gujarat, India

ABSTRACT

Artificial Intelligence and Data Mining are tools powerful enough to revolutionize the world including chemical industries. They can be use for different applications from molecular synthesis to Optimizing the processes in real time. In this paper we have explained how can these techniques be used to improve the performance of any chemical plant. Chemical Industries have stored piles of data of processing parameters stored on the servers and it is impossible task for human to analyze those data manually but with the advanced high performance computing those data can be accurately analyzed. That stored data is now became the greatest asset to learn about the actual process parameters compared with the theoretical models. Then Integrating these models to Artificial Intelligence will enhance the performance of the process.

Keyword : - Artificial Intelligence (AI), Machine Learning, Data Mining, Chemical Processes

Introduction to Artificial Intelligence and machine learning to chemical industries :

Artificial intelligence (AI) is the branch of computer science that deals with designing intelligent computer systems that mimic human intelligence. The ability of machines to process natural language, to learn, to plan makes it possible for new tasks to be performed by intelligent systems [1].

The main role of AI will be to create a virtual agent say operator in our case. If we don't induce enough intelligence to AI then it will not be efficient and to induce the intelligence we have to use the machine learning which are the computer programmes which occupies a large area within AI, programmed such a way that it learns from the tasks (Operating Parameters in our case) and improve the performance with experience. Machine Learning involves the study of algorithms that can extract information automatically.

Lot of companies have invested millions of dollars in the field of Artificial Intelligence because of its application in real time operations. Because of AI, tons of automation applications are became possible. One of the key feature of AI is that it can be integrated on any existing solutions. It helps to enhance the performance or to atomize the operation. In process industries there are quite a few companies who provides online optimization systems for certain applications which are built on the theoretical models but other than online optimization there are several other applications where AI can be used are as follow [2] :

- Chemical Synthesis and Analysis
- Process Control and Atonization of Plants
- Safe Operation Including Start up and Shut Down and Emergency Shutdown
- Operational Planning - Equipment Work Life Cycle Prediction and planning preventive maintenance

- Optimization with actual Plant Dynamic Models
- Waste Minimization[3]
- More energy efficient processes

Introduction to Data Mining to chemical Industries :

Data Mining is very much similar to Machine Learning but it has different applications. Data mining is carried out by a person, in a specific situation, on a specific data set with a goal in mind. It can be used to leverage the power of the various patterns recognition techniques which are developed by machine learning. For chemical process industries these data sets are usually large and complicated and for each processes we have different goals to achieve. In such cases data mining can be use to get preliminary insights in an area where there was really little knowledge was available before predict future behavior accurately.

The chemical industry had gone through rapid growth in the United States and all over the world. Success has so emboldened the chemical industry that it regards itself as capable of solving any problems [4].

Method that can be use to develop Process Specific AI :

AI, Machine Learning and data mining requires very good programming skills and strong command on advance mathematics with excellent process engineering knowledge. Apart from these, the more data we exposed to the machine learning algorithms the better it will understand the process and the final AI will be more efficient. So, we have two options for that, we allow AI to learn for years with day to day operations or we use previously stored data to induce intelligence in AI by algorithms. With the technology such as AI, stored data can add great value to process. As this techniques requires different skill set person to design it and very advance level computation, made difficult for small industries to implement them. One major challenge is that, in each chemical industries we have a different goal to achieve. So, we need to develop the algorithms such a way that it includes all parameters of the process and a single AI can be developed for that particular process which then can be integrate with the control system and the performance of plant can be enhanced in terms of safety and productivity. A basic Flow Chart is shown below for developing the AI for chemical Industries.

In the flow sheet, how operating conditions and other parameters recorded during the operation can be use to develop a plant specific AI is shown. The main advantage of the AI developed by this method is, it will work for the specific process very well as we can induce tons of intelligence from the data recorded during previous processing. The AI developed will not only be able to predict the future behavior but also it can act as the virtual operator which will control the process parameter to increase the overall profitability and safety of the plan.

Predicting the behavior of any process can be done by simulation and there are few software available for this purpose and many of them allow us to do dynamic simulations. So the question arises what is the difference between the simulators and the developed AI.? Basically the simulation works on only theoretical model and can be use for getting an overview just like we do in data mining. One more limitation is that we can simulate process based on the data we are feeding but the actual plant dynamics can be considerably vary yet we can use simulators as a basic tool for data mining in few cases but we can't predict accurate behavior of whole process with the simulators in many cases and hence for such cases we have to develop a specific AI.

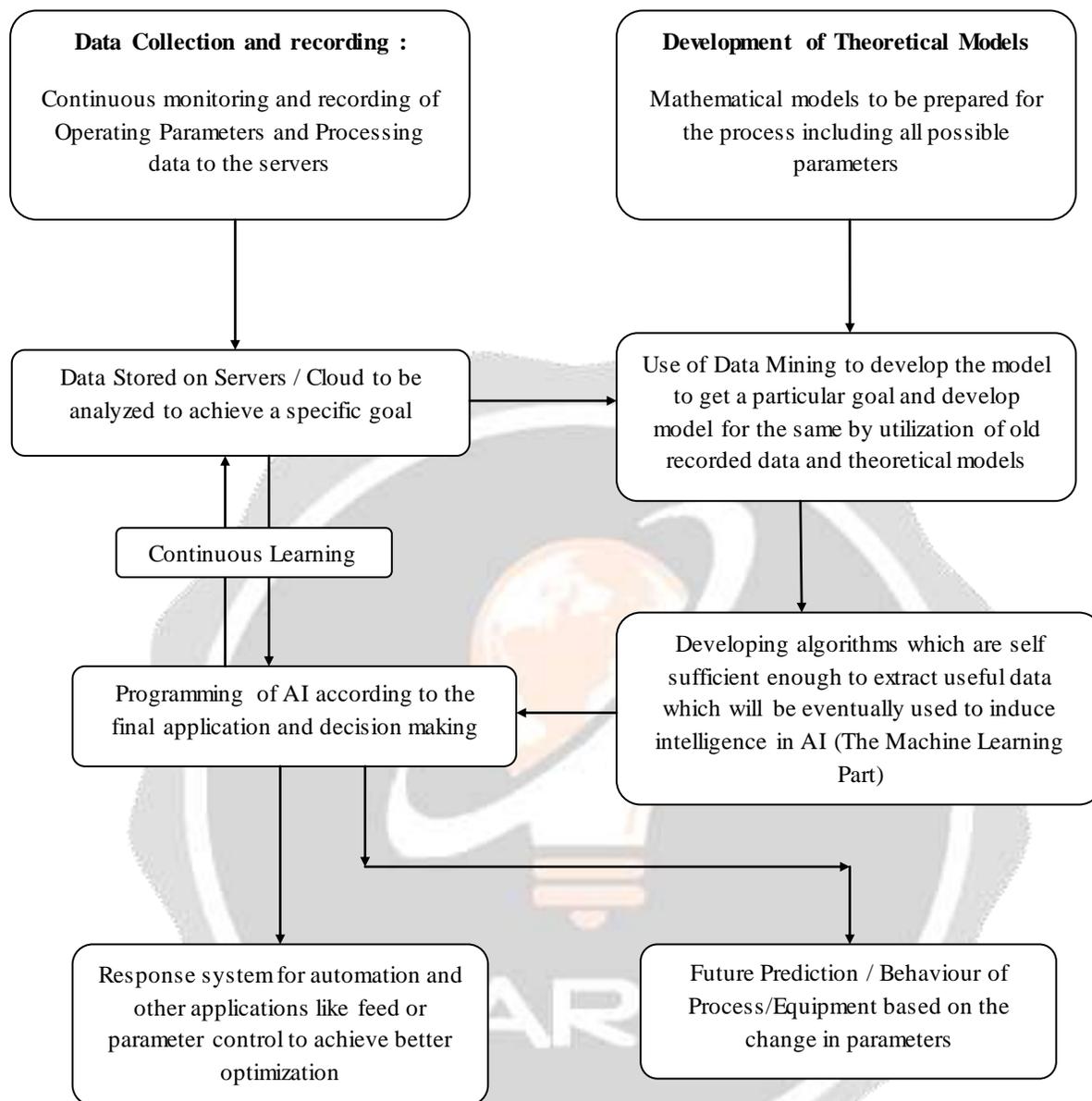


Figure - 1 : A fundamental flow diagram to Develop AI for chemical Industries

Reference :

- [1] M. N. O. Sadiku, "Artificial Intelligence", IEEE Potentials, May 1989, pp. 35-39.
- [2] Matthew N. O. Sadiku, Sarhan M. Musa, Osama M. Musa "Artificial Intelligence in Chemical Industry", ISSN 2350-0328, Vol. 4 Issue - 10 pp. 4618-4620
- [3] Y. L. Huang and L. T. Fan, "Artificial intelligence for waste minimization in the process industry," Computers in Industry, vol. 22, 1993, pp. 117- 128.
- [4] C. Duisberg, "The latest achievements and problems of the chemical industry," The Journal of Industrial and Engineering Chemistry, Oct. 1912, pp. 149-760.

BIOGRAPHIES :



Krunal Shah has done his M. E. Computer Aided Process Design from L. D. College of Engineering, Ahmedabad, India. He is currently working as freelance and consultant in the area of Process Modeling, Optimization and simulation work with local groups as these are his area of expertise. He is also having a very strong command over chemistry and has successfully developed few specialty products mainly used in dentistry and successfully ventured a company manufacturing those products.

Email - info@krunalshah.me

