Academic Journal of Engineering and Technology Science
ISSN 2616-5767 Vol.3, Issue 4: 179-183, DOI: 10.25236/AJETS.2020.030417

Opportunities and Challenges Faced by Control Engineering in the New Era

Junjie Zhao

Institute of computer and control engineering, North China Electric Power University, Baoding 071000, China
1224073665@qq.com

ABSTRACT. *As a new wave, big data and artificial intelligence is triggering deep changes in the field of control engineering, and technology is reshaping the shape of control strategies.Control engineering is facing new challenges. This article analyzes the definition of big data, the relationship between big data, artificial intelligence and control engineering, and the impact of them on control engineering, providing a reference for the future development direction of control engineering.*

KEYWORDS: *big data, artificial intelligence, control engineering*

1. Introduction

Today, with artificial intelligence and big data blowout, the field of control engineering is also undergoing dramatic changes. The control strategy of single-loop feedback control is acceptable, but the parameters need to be adjusted. If the settings are not suitable, the system may be unstable, which is counterproductive. On this basis, the single loop plus cascade control, cascade plus feedforward control, Darling algorithm, Smith control, and minimum beat system control, etc., can all have better control effects under ideal conditions. However, with the complexity, large-scale, non-linearity and time-varying nature of the controlled objects, these traditional algorithms often need to be alienated for application scenarios, some change the structure of the controller, some find more measurement points, and some choose to control deviation instead of controlling a single controlled quantity. Big data technology and artificial intelligence technology can provide new ideas for the formulation of control strategies.

The PID controller can only collect the information of the current control processing and then exert the control effect. However, by using big data technology, the dynamic characteristic information of this object in multiple production processes will be collected and the characteristics of the object will be learned using artificial intelligence technology. The resulting control strategy will be more effective than traditional strategy.

ISSN 2616-5767 Vol.3, Issue 4: 179-183, DOI: 10.25236/AJETS.2020.030417

This article will summarize from the perspective of the relationship between big data, deep reinforcement learning technology and control engineering. The main structure is as follows: First, big data and deep reinforcement learning technology are introduced; then, introduce the possible relationship between the big data, deep reinforcement learning technology and control engineering; after that, analyze the research trends and application prospects; finally conclude.

2. Big Data

Since it was proposed, big data has received extensive attention. However, there is no unified definition of big data yet. As it is a relative concept, the current definition of big data is a qualitative description without explicit quantitative indicators. Wikipedia points out that big data refers to a data set that uses common software tools to capture, manage and process, and its elapsed time exceeds the tolerable time limit [1]. McKinsey, a world-renowned management consulting company, refers to the data set that exceeds the acquisition, storage, management and analysis capabilities of traditional database management software as big data [2]. Gartner, a research firm, classifies big data as massive, high-growth and diversified information assets that require new processing modes to enhance decision-making, insight and process optimization [3]. In his report at the 462nd Xiangshan Scientific Conference, Academician Xu Zongben defined big data as "a massive complex data set that cannot be stored centrally and can hardly be analyzed and processed within an acceptable time, in which individual or part of the data presents low value while the data as a whole presents high value". Although the above definition methods, angles and emphasis on the definition of big data are different, the information transmitted is basically the same, which define big data a data set in the final analysis. Its characteristics are highlighted by comparison with traditional data management and processing technologies, and under different requirements, the required time processing range is different. The most important point is that the value of big data is not the data itself, but the reflected "big decision", big knowledge", "big problem", etc. [4].

3. Application of Deep Reinforcement Learning

In the field of artificial intelligence, perception and decision-making ability are both indicators of measuring intelligence. Directly learning high-dimensional perceptual input (such as images, voice, etc.) to control the agent is a long-term challenge for reinforcement learning. Reinforcement learning has made great progress in the theory and algorithm of strategy selection, but the quality of results of reinforcement learning depends heavily on the quality of feature selection [5]. The recent development of deep learning has made it possible to extract high-level features directly from the original data. Deep learning has strong perception ability, but lacks certain decision-making ability, the neural network training model is shown as figure 1; while reinforcement learning has decision-making ability, but it is helpless to perceive problems. Therefore, combining the two, complementing

ISSN 2616-5767 Vol.3, Issue 4: 179-183, DOI: 10.25236/AJETS.2020.030417

each other's advantages, provides a solution for the perception decision problem of complex systems [6].

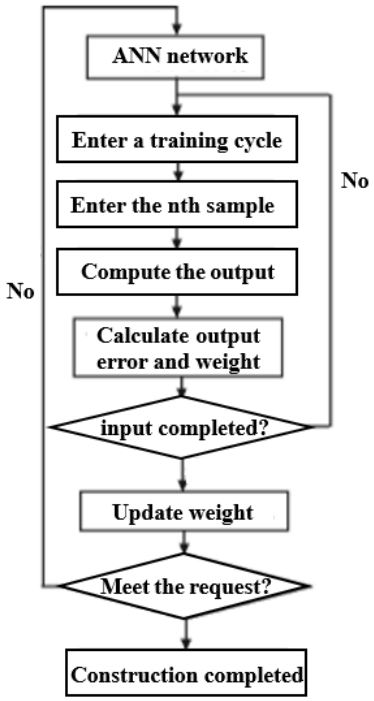

Figure 1. The neural network training model

Deep reinforcement learning is a product of the combination of deep learning and reinforcement learning, and is a more effective artificial intelligence algorithm. It plays a huge role in playing video games, autonomous driving, robotics and other fields. After just two weeks of training, Google's DeepMind has shocked the world with its AI Alpha Star defeating two top human professional players by 5:0 in the "StarCraft" game. How to apply this powerful algorithm to control engineering is a subject that control engineers need to think about and practice in the future.

4. Big Data and Control Engineering

It can be seen from the definition that the data itself is worthless. To refine the value of big data, algorithms, computing power, and data are indispensable. However, in the field of control engineering, if you want to refine the value of big data, you need neural network control technology to provide algorithms, powerful hardware to provide computing power, and big data technology to provide data.

ISSN 2616-5767 Vol.3, Issue 4: 179-183, DOI: 10.25236/AJETS.2020.030417

The complexity, large-scale, non-linearity and time-varying nature of the controlled objects have put forward new requirements for control engineering, and neural network control looks like the most potential answer. One challenge that must be faced in the field of control engineering in the future is "how to integrate with AI technology". If the future neural network controller can apply deep reinforcement learning technology, use the collected big data of the controlled object to train the neuron parameters in the controller to make it have the ability of "recognition" and "decision-making", then compared with traditional controllers, the control effect of such neural network controllers must be excellent and satisfactory which is shown as figure 2.

However, with such a control strategy, the acquisition cost of big data, the acquisition cost of computing power, and the development of new algorithms (mainly reflected in the development of neural network structures suitable for control engineering) are huge. Besides, the trained controller has Non-migration which means all will be one-time investment making the Investment prospects pessimistic.

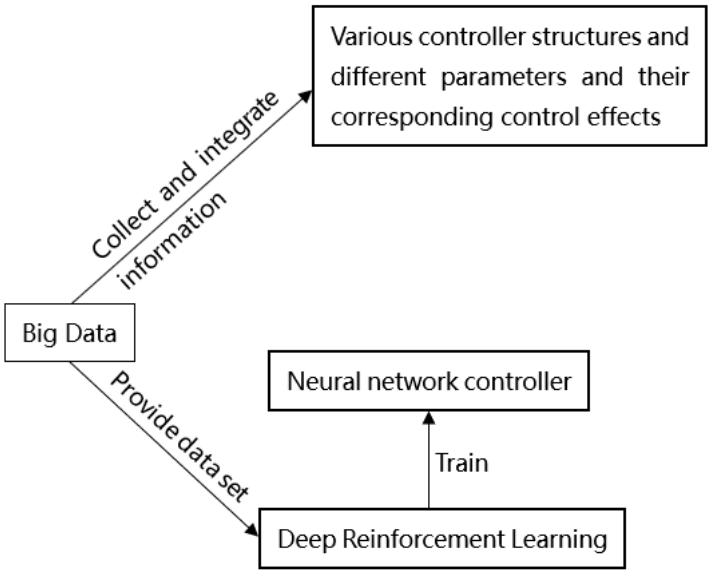

Figure 2. The process of making a neural network controller in the future

5. Conclusion Remarks

Neural network control is both an opportunity and a challenge. Such a big data-driven control strategy has both excellent performance and high cost. How to maximize the potential of developing neural network control and how to optimize its

ISSN 2616-5767 Vol.3, Issue 4: 179-183, DOI: 10.25236/AJETS.2020.030417

use cost will become the main theme of the development of control engineering in the future.

References

[1] ZHANG Yaoxue, REN Ju, LIU Jiagang, etal. A Survey on Emerging Computing Paradigms for Big Data [J]. Chinese Journal of Electronics, 2017 (05).
[2] Zhao Feifei, Jin Yanliang, Xiong Yong. Sensing system based on WiFi probing [J].Electronic Measurement Technology, 2016, 39 (10).
[3] Miao Yongmei. Anomaly detection based on large data analysis applied to petroleum catalysis [J]. Electronic Measurement Technology, 2017, 40 (07).
[4] Peng Yu, Pang Jingyue, Liu Datong, Peng Xiyuan. Big data: connotation, technical framework and its development [J]. Journal of Electronic Measurement and Instrumentation, 2015: 11–24.
[5] MNIHV, KAVUKCUOGLUK, SILVERD, etal. Playing atari with deep reinforcement learning [C] //Proceedings of the NIPS Workshop on Deep Learning. Lake Tahoe: MIT Press, 2013.
[6] ZHAO Dong-bin, SHAO Kun, ZHU Yuan-heng, etal. Review of deep reinforcement learning and discussions on the development of computer Go [J]. Control Theory & Applications, 2016, 33 (6): 701-717. DOI:10.7641/CTA.2016. 60173.