（一） 計畫英文摘要

In Productivity 4.0, an important characteristic is that production systems (e.g., machines, warehouses, and operating entities in production) are able to communicate with each other, interpret available data, trigger actions and have the capability for autonomous self-control and self-optimization. An important application scenario in Productivity 4.0 is intelligent machines or smart factories which are able to predict breakdowns or quality problems and organize maintenance in time. They use patterns and knowledge in historical data from the production network to enhance their decisions processes and take actions. With the fast development of networking, sensor, and data storage, information coming from production systems generates a “big Data” issue. It becomes difficult to manage big data by simply using existing database management concepts and tools; therefore, using machine learning techniques to obtain valuable information from the massive data of complex structures has become a common concern yet an urgent problem.

We aim to build a platform for big data processing in response to the demands of smart manufacturing productivity from Taiwan industry. The proposed platform consists of two components, the big-data-analysis (BDA) platform and the manufacturing-decision-support (MDS) system. The BDA platform provides big data analytical tools such as Hadoop MapReduce, Spark, and TensorFlow, that can be used to build various machine learning applications. The BDA platform first acquires data from manufacturing-related databases, historical data of IIoT devices, and human expert knowledge. It then performs big data analysis and produces digital production rules and a series of progressive prediction models for defect-free rate prediction. The MDS system is responsible to support soft real-time decision-making using the real time information from each manufacturing station of the production line. The information is sent to the progressive prediction models that run on a private OpenStack cloud. Then the output data of the models are sent to the production line managers to help their decisions. Since we only have very limited information for a product at an early station of the production line, the corresponding prediction model may not be useful in practice. To this end, we also employ a rule-based solution as the second prediction mechanism to help the production line managers.

In this two-year project, we propose to use some machine learning tools to incorporate with the expertise of some experienced engineers to build a prediction model for the yield rate of the production line at the first year. We plan to build the proposed platform in the first year. At the second year, we will propose a new machine learning tool which can provide explanations about its predicted outputs. Based on the explanations, engineers in the production line can enhance their decisions processes in time to overcome breakdowns or quality problems. We then port the proposed platform on the production lines of our industry partners in the second year. We also plan to add an automatic rule generator and a rule-matching mechanism in the second year to enhance the MDS system. The major goal of the proposed platform is to respond a user request in less than a minute, while maintaining its availability at 99%.

Keyword: Big Data Analysis, OpenStake, Productivity 4.0, Progressive Prediction Problem, Rule-based Reasoning.