INFORMATION
Volume 27, Number 1, pp.77-89

ISSN 1343-4500 eISSN 1344-8994

Prediction Model Using LSTM-Based Double-GAN in CNC Machining

Junhae Lee*, Sooeun Lee**, Sangjoon Park***

*Computer Science Department, University of Wisconsin-Madison, Madison, USA
E-mail: jlee2294@wisc.edu

** Exclusive Business 1 Term, Military Mutual Association C&C Inc., Seoul, Korea

*** Computer Information Engineering Department, Kunsan National University, Gunsan, Korea

Abstract

This paper proposes an anomaly prediction model that can detect machining defects using the GANs and LSTM, and analyzes the data extracted from the sensors built into the CNC machine. To achieve this, we first select meaningful features from CNC facility data and apply them to the GAN, augmenting data of CNC machining. This approach helps overcome issues related to data scarcity and imbalance, ultimately generating anomaly detection factors for identifying defective products. In numerical results, through the proposed model of LSTM-based Double-GAN, their application in manufacturing processes, we contribute to substantial improvements in practical quality and cost savings.

Key Words: CNC machining data, Double-GAN, Anomaly prediction, Data analysis, Quality Defects

1. Introduction

CNC machines can be programmed to perform a variety of operations and be used to manufacture a wide range of products, enabling shaping with a high degree of freedom of material and shape, as well as extremely high machining quality and precision. Therefore, the CNC machine is actively used in various industries such as the automotive industry, aerospace industry, and machinery manufacturing [1, 2]. In CNC machine, the cutting tool can be damaged by friction or a sudden change in cutting force. These situations can lead to a sharp decrease in machining accuracy. The increased cutting force can also affect the life of the machine tool. Therefore, it is necessary to predict the possibility of CNC machining defects according to tool life to ensure the uniform quality and reproducibility of the product. CNC machined products are difficult to detect problems during the manufacturing process in real-time. The product defect can only be known after the product is molded.

To identify problems in the CNC machining, the first step is to analyze the characteristics of the data collected during the process. In CNC machining, the life condition of the cutting tool determines whether the product is processed good or defective, so a functional relationship exists between the input and output variables. Therefore, the data generated during the process is characterized by non-linearity and non-normality, so it is essential to check the correlation