IC-PBL Report

Title	Maximizing efficiency of predicting optimal engineering conditions for composite materials using tree-based model Tree-based model을 이용한 복합소재의 최적 공적 조건 예측 효율 극대화
Members	한요셉(2021135188), 현지은(2022157011)
Problem (What)	Composite materials using thermoplastics are developed by combining various types of plastics with fillers or additives. In order to develop a composite material suitable for the purpose, the researcher is accompanied by various experimental designs according to the composition of the composite material and process conditions. Most of the experimental processes are directly tested without a separate mechanical automation process, and are derived through trial and error. Attempts are being made to apply artificial intelligence to the process of mixing composite materials and optimizing process conditions to solve the problem of time and cost required at this time. Currently, a commonly used model is an artificial neural network model. When the artificial neural network model is applied to the process of predicting the optimal composition and process conditions during the composite material research process, higher predictions can be expected in these nonlinear problems. However, it has the disadvantage of being a black box model that requires more computational cost and time than other models and is difficult to interpret the prediction cause. A black box model refers to a model in which the basis for deriving an output from an input is unknown. Contrary to this, the white box model refers to a model in which the basis of the output derived from the input can be known.
Reasons (Why)	The artificial neural network model is a black box model, and it is difficult to interpret the evidence for the results predicted through data, so there may be limitations in applying the analysis results and models to new experiments. In addition, artificial neural network models are more applied to the analysis of unstructured data such as image or string data. However, data on composite material mixing ratio, process temperature, etc. are structured data that can be represented as table data, and are not suitable as a source for artificial neural network models, so the computational cost-effectiveness is low. Expectations for optimal process condition prediction performance using an artificial neural network model may be high, but it can be applied to new

	experiments and higher prediction performance can be expected when a model more suitable for the source data is used.
Solution (How)	As computers and various mathematical and statistical algorithms have been developed, various problem solving methods using artificial intelligence have been proposed. The problem of reducing time and cost for composite material development aims to predict the physical properties of the desired material after creating and learning an artificial intelligence model using data generated from material development. The data that can be obtained from composite material experiments are structured data. An artificial intelligence model suitable for the data is considered to be a tree-based model that is widely used for tabular data rather than an artificial neural network algorithm that is widely used for unstructured data. In composite material research, we try to solve the problem by using a tree model instead of the existing artificial neural network model. A tree-based decision-making model is an algorithm that operates with the goal of dividing a feature space into multiple regions. It makes predictions for given observations based on mean (regression) or mode (classification) of the feature space. The data obtained as a result of the experiment can be expressed as table data, which is structured data, and it can be said that the tree model is more suitable than the artificial neural network model for analyzing and predicting data as a source. In addition, the tree model belongs to the white box model and has the advantage of being able to check the analysis and predicted process and grounds.