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Prediction of warp distortion in circuit board using machine learning

Koki TOSUJI[1*], Yoshitaka WADA[2*]

[1] Kindai University, Higashi-Osaka, Japan, 2133330352r@kindai.ac.jp
[2] Kindai University, Higashi-Osaka, Japan, wada@mech.kindai.ac.jp

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Lead-free solder has become common as environmental concerns increase. Since the maximum temperature of furnace has been increased by the solder, the temperature conditions has become strict. Defects of solder joint have increased due to circuit board warp. If the displacement of board warp is predicted, the defects will be decreased by modification of product design. In this study, we'd like to employ a convolutional neural network, characterize the data relations as a feature, for the prediction of circuit board warpage. The objective is a prediction of the amount of board warp using very limited results of several experimental measurements.

All of input data which include material properties and so on are standardized between 0 to 1. The output data is standardized warp displacement of 9 points in vertical direction on the surface of circuit board. Since a number of original data is very limited, it is necessary to augment training data sets. However, usual augmentation techniques just interpolate closed data in a parameter space. In short, the improvement of the prediction accuracy is limited. We'd like to propose a method called as factor levels augmentation. The fundamental factor levels augmentation is linear interpolation, however it may not be able to represent actual physical phenomena which usually contains nonlinearity. Nonlinear interpolation according to physical phenomenon produces better training data sets.

Prediction accuracies between no augmentation data and factor levels data augmentation is compared. In the case of no augmentation, the prediction results include 40 errors over 20%. In the case of factor levels augmentation, the highest errors are less than 5%. The significance of the factor levels augmentation is confirmed. It is important to keep the trend and characteristics of the dataset remember when using factor levels augmentation so that points with different trends are not taken. We'd like to discuss more appropriate general data augmentation techniques using a smaller number of original data.

REFERENCES

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