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Solving Small Sample Recipe Generation Problem with Hybrid WKRCF-PSO

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ABSTRACT

The cost of the experimental setup during the assembly process development of a chipset, particularly the under-fill process, can often result in insufficient data samples. In INTEL Malaysia, for example, the historical chipset data from an under-fill process consist of only a few samples. As a result, existing machine learning algorithms for predictive modeling cannot be applied in this setting. Despite this challenge, the use of data driven decisions remains critical for further optimization of this engineering process. In the proposed framework, the original weighted kernel regression with correlation factor (WKRCF) is strengthened by normalizing the input parameters and employing the Particle Swarm Optimization (PSO) as weight estimator. It is found that PSO gives flexibility in defining the objective function as compared to the iteration technique of WKRCF. Thus, an assumption on noise contamination to the available training samples can be implemented. Even though only four samples are used during the training stage of the conducted experiment, the proposed approach is able to provide better prediction within the engineer's requirements as compared with WKRCF. Thus, the proposed approach is beneficial for recipe generation in an assembly process development.

KEYWORDS

Correlation Factor, Normalization, Particle Swarm Optimization, Recipe Generation, Small Samples, Weighted Kernel Regression

1 INTRODUCTION

Recipe generation provides the key references needed by engineers to set up a new experiment for a new product and plays an important role in determining the success of product development. Currently, the ingredients chosen for the recipe mainly depend on the engineer's knowledge. Optimizing the input parameters will facilitate the engineering decisions needed to fulfill certain requirements. As the assembly process for chipsets is rapidly progressing towards smaller scales and greater complexity, the accuracy and efficiency requirements are more vital. For example, a semiconductor process flow requires hundreds of fabrication operations steps with a lead-time of a few months. In addition, device fabrication and manufacturing costs