Contribution ID: **35** Type: **not specified**

Adhesive bonding process optimization via Gaussian Process models

Wednesday, 15 September 2021 12:20 (20 minutes)

Adhesives are increasingly used in the manufacturing industry because of their desirable characteristics e.g. high strength-to-weight ratio, design flexibility, damage tolerance and fatigue resistance. The manufacturing of adhesive joints involves a complex, multi-stage process in which product quality parameters, such as joint strength and failure mode, are highly impacted by the applied process parameters. Optimization of the bonding process parameters is therefore important to guarantee the final product quality and minimize production costs.

Adhesive bonding processes are traditionally determined through expert knowledge and trial and error, varying only one factor at a time. This approach generally yields suboptimal results and depends highly on the experience and knowledge of the process designer. Additionally, the bonding process parameters, jointly determine performance and cost metrics in a complex, nonlinear way. Therefore, a more efficient optimization method is desired.

This research discusses the use of Design of Experiments with Bayesian Optimization and Gaussian process models to optimize six bonding process parameters for maximal joint strength. The approach was first applied in a simulation environment and later validated via physical experiments. In the intermediate result, this novel method showed 2% reduction in production cost and 15% reduction in optimal solution search, compared to the traditional approach with similar joint strengths. Final results will be presented at the conference.

This research received funding from the Flemish Government under the "Onderzoeksprogramma Artificiële Intelligentie AI Vlaanderen"program. This research was supported or partially supported by Flanders Make vzw.

Keywords

Process optimization, Bayesian optimization, Gaussian processes

Special/invited session

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Session Classification: Design of Experiment 2

Track Classification: Design and analysis of experiments