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Estimating the heating duration of composite parts in the autoclave curing process using regression and artificial neural networks

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The use of composite materials has been increasing in all production industries including the aviation industry, due to their strength, lightness, and design flexibility. The manufacturing of composite materials finalizes with their curing in the autoclaves that are heat and pressure ovens. The autoclave curing cycle, in which a batch of materials is cured in the autoclave, is made of three stages; all materials are heated up until the curing temperature (heating stage), cured at the curing temperature (curing stage), and cooled down to room temperature (cooling stage). This curing cycle should be shortened to better utilize the autoclaves. We consider the heating stage and aim to minimize its duration by efficiently placing the parts in the autoclave, such that the duration for all parts to reach the curing temperature is minimum. To achieve this, we need to use the relationship between how parts are placed in the autoclave and their heating durations, which is currently not known for the parts and the autoclave considered.
In this study, we estimate the heating duration of parts depending on how a batch of parts is placed in the autoclave. We use two methods, multiple linear regression and artificial neural networks, and develop different models for each method by either partitioning the autoclave area in smaller subareas (area-based models),and considering the autoclave region as a single area (single-area models). We propose the best model by evaluating their performances on real test data.

Type of presentation

Talk

Classification

Mainly methodology

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