

Blade Envelopes: Overview and Challenges

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A blade envelope is a probability distribution in the physical 3D space. It represents the variation associated with the manufacturing process but captures the intended aerothermal and structural performance properties of the blade. This perspective is a contrast to many approaches to view manufacturing data and its relationship with the design space. Indeed, in many manufacturing processes, covariance is seldom considered, and any analysis or decision is based on a few standard deviations.

So, what does this new perspective yield? First, it offers a framework to coalesce design and manufacturing data — directly connecting design criteria with what gets manufactured. Second, it offers easy-to-implement techniques for ascertaining whether a manufactured blade should be used or scrapped. Third, it charts a course to understand how we can build models that capture manufacturing variation, and even predict them, for new blade geometries.