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Implications of design optimization on geometry generation in aerospace

Airplane design, and vehicle design in general, is evolving. The traditional technique was for an experienced designer/engineer with a real talent for design and a large personal knowledge base to draft a single vehicle in a CAD system; analyze it for pertinent properties (like the lift provided by the wings, the drag of the vehicle, its structural integrity, predicted fuel consumption, etc.); and decide if it meets the market's needs. If it doesn't, which is typical, the next step was essentially to go back to the drawing board to see if it can be tweaked to do so. More recently, the designer may provide a baseline design to which small perturbations can be made. Then an optimization package can try to hone in on an acceptable design... as long as there is one that is nothing more than a minor modification of the baseline.

The next step in this evolution is for the designer to design an entire family of vehicles that depend on a set of parameters, i.e., a bunch of virtual knobs that can be turned to morph the vehicle, allowing for more significant changes so a larger set of vehicles can be studied. In this presentation we show why existing CAD packages are ill-equipped for this new approach, present some of the tools we have developed to address the issues and give a taste of the kinds of mathematics behind these new tools.