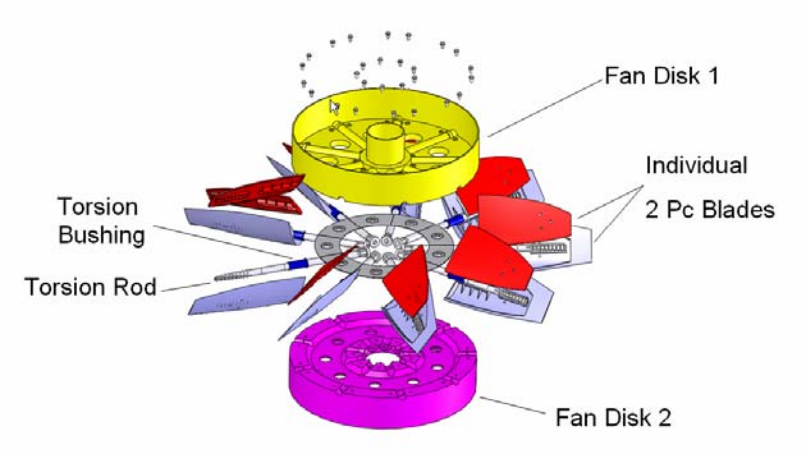
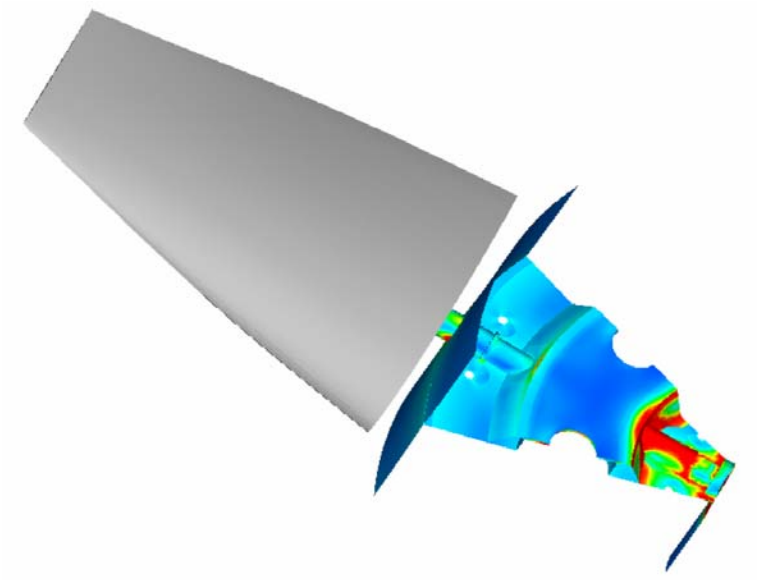
Aerospace Case Study **(Howarth Development Associates – Variable Pitch Ducted Fan)**





Howarth Development Associates (HDA) is a design and development firm specializing in cost saving designs using plastic and reinforced composite materials as an alternative to heavier and more expensive metal counterparts (www.metalreplacement.com).

HDA took part in a NASA sponsored effort to develop low cost, efficient, quiet solutions for a propeller system for Personal Air Vehicles, a light point-to-point aircraft. Typical designs for variable pitch propellers were both complex and costly using either mechanical or hydraulic actuation to achieve changes in blade pitch.

HDA in conjunction with their design partner MSK Associates recognized that extreme cost reductions were possible by using the centrifugal force on the propeller blade and the inherent material anisotropy of composites to achieve pitch variations without compromising system efficiency or noise. In the design, they modeled the weight of the blade pulling against a continuous fiber composite torsion rod with asymmetric fiber architecture. By orienting more fibers in one direction of wrap along the torsion tube than the other, stiffness difference results. This stiffness difference causes rotation of the tube under axial extension, as the centrifugal force on the blade pulls on the tube.

HDA were able to develop their innovative solution by using the composite analysis capabilities in NEi Nastran and Femap. User friendly definition of material properties, ply lay-up and orientation were among some of the ease-of-use features that cut engineering time. The surface contact played a key role in accurately capturing the complex interaction of the mating/sliding components, particularly at the torsion rod/bushing interface. Post-processing visualizations that pinpointed problem areas, modern failure indices and configuration trade-off studies helped to provide critical engineering insights. The estimated cost savings was about 50:1 compared to a traditional variable pitch propeller.

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