The Royal Academy of Engineering

Global Research Award

Advanced Aircraft Design Methodologies

Hosted by Georgia Institute of Technology, USA

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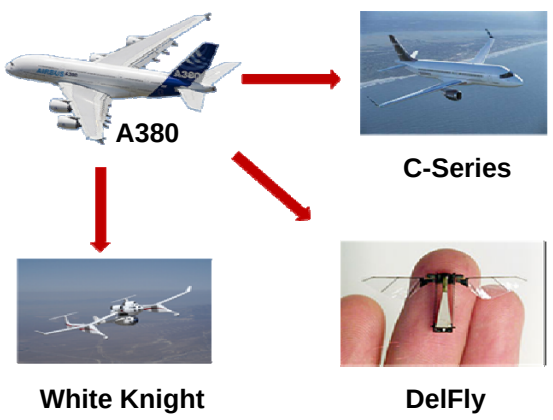
Introduction

The design of commercial airplanes hasn't changed significantly in the last 50 years, and the methods used in their design are heavily influenced by statistics based on this narrow range of configurations and technologies. The new materials and advanced technologies required for the next generation of aircraft need new design tools to facilitate decision making in order to fully exploit their capability.

But, for computational tools, fidelity beyond the product definition is ineffective, and hence capability is needed to refine the product definition more quickly. For example, maintenance intervals in principal structural elements are determined by crack growth properties which operate at a localized level.



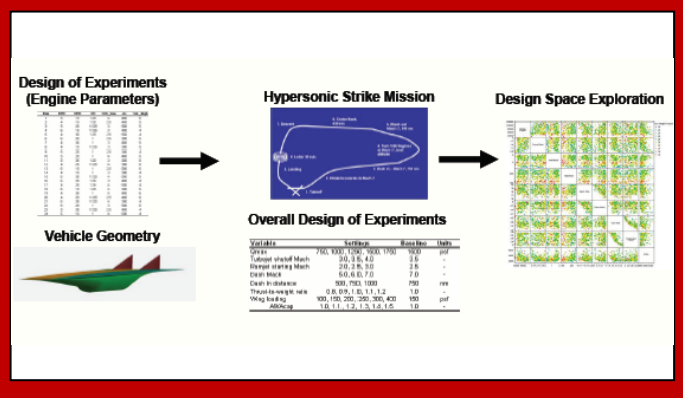
Tools are needed to move from today's latest aircraft to new commercial craft, one-off designs and micro-air vehicles.

The Challenge

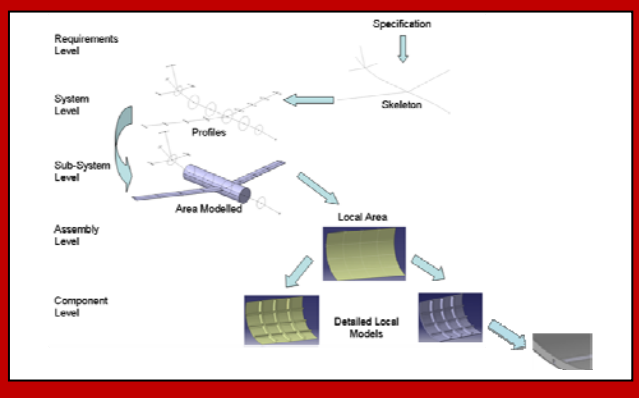
The challenge was to combine the systems level exploration tools with the detailed product definition tools to produce an effective trade-off capability.

Methodology

The Aerospace Systems Design Lab (ASDL) has developed advanced analytical methods to enable exploration of a wide design space providing more configuration options for the system. QUB has developed modeling tools to rapidly generate detailed airframe structures. The approach taken was to combine these two approaches using integration software and bespoke tools to result in a tool capable of providing trade-off data.



ASDL System tools (right) are combined with QUB Structural Design tools (left)



Achievements

- A rudimentary design process has been established which links localized structural details with system level models and allows identification of parameter sensitivities.
- A simple trade-off tool has been generated which uses system level models and structural details to provide data on how structural technologies influence the vehicle cost and performance. The system uses spreadsheets, commercial software for integrated applications and CAD systems.
- A collaborative relationship building on the complementary skills of each partner has been established.
- A gap analysis of design capability has been carried out, providing research ideas for design methods in composites, design methods and manufacturing integration with design.

ASDL

Queen's University Belfast