



DEPARTMENT OF AUTOMOTIVE AND AERONAUTICAL ENGINEERING

# Conceptual Design Optimization of a Strut Braced Wing Aircraft

## Background

The first step in aircraft design consists of finding consistent aircraft parameters that ensure the aircraft meets given requirements. Subsequently, this first set of aircraft parameters is varied such that an objective function is optimized. The objective function most often applied in civil aviation are Direct Operating Costs (DOC) which are to be minimized. The optimization involves – even in conceptual design – so many parameters that an aircraft specific optimization algorithm has to be used. The program Optimization in Preliminary Aircraft Design (OPerA) is available for this purpose at Hamburg University of Applied Sciences. A Strut Braced Wing (SBW) Aircraft is seen to have a potential replacing today's short-medium range aircraft. The strut relieves bending moments at the wing root. This advantage can be used to reduce wing mass maintaining span or to increase span at constant wing mass. Both approaches will reduce induced drag. Alternatively, relative wing thickness may be reduced at constant wing mass offering the chance to reduce wing sweep and supporting natural laminar flow, hence reducing zero lift drag. Snowball effects will reduce aircraft mass even more, reducing fuel consumption and emissions.

## Task

Task of this Master Thesis is to investigate possible configurations and to optimize aircraft parameters (with and without wing span limitation) for a jet propelled Strut Braced Wing Aircraft (SBWA). The optimization shall consider various typical objective functions and should finally also include questioning and optimizing requirements like cruise Mach number, take-off and landing distance. Subtasks are listed below.

- Brief review of the SBWA concept including a brief discussion of wing span limitations at airports.
- Brief introduction to OPerA and description of modification in OPerA to allow also for optimization of other configurations than the standard tail aft, low wing passenger aircraft. Inclusion of the new DLR/HAW proposed Unified Cost Method (UCM) in OPerA.

- Investigation and preliminary optimization of SBWA configurations including high versus low wing, standard tail versus T-Tail, engines on wing versus engines on aft fuselage, wing mounted landing gear versus fuselage mounted landing gear – all based on “DLR Design Challenge 2012” requirements for a short-medium range passenger aircraft.
- Selection of a SBWA configuration and further optimization with respect to various cost functions: Primarily working with the UCM (COC and DOC) investigating also other basic and more sophisticated methods like Added Values.
- Final proposal of a SBWA and presentation as an electronic 3-D model either for X-Plane with the Plane Maker or with OpenVSP.

The report will be written in English based on German or international standards on report writing.