DEPARTMENT OF AUTOMOTIVE AND AERONAUTICAL ENGINEERING

Optimization Algorithms Applied to Aircraft Preliminary Sizing and Cabin Design

Task sheet for project work

Background

Although substantial research has been undertaken into the application of formal optimization algorithms to aircraft preliminary sizing and conceptual design, these steps are in practice still to a large extend driven by experience. Aircraft design in the later stages of the development process would require Multidisciplinary Design Optimization (MDO) to find the optimum combination of all aircraft parameters related to one another. However, due to the complexity of the total aircraft design task, MDO is usually limited to a coupling of aerodynamics and structures. Optimizing cabin design has been approached with Knowledge Based Engineering (KBE). In the frame of cooperative doctoral studies at HAW Hamburg it is the aim to investigate MDO linking aircraft preliminary sizing and cabin design. Optimization algorithms can be divided into three main groups: Stochastic algorithms, genetic algorithms and deterministic algorithms. Suitable algorithms for an MDO linking aircraft preliminary sizing and cabin design will have to be selected from one or more of these three groups.

Task

The task of the project is to find suitable algorithms for an MDO approach linking aircraft preliminary sizing and cabin design and to get to a first understanding of their characteristics to the problem. Work of the project should follow these steps:

- Selection of suitable optimization algorithms based on a literature review.
- Set up of the selected algorithms on the computer (ready to use public domain tools should be used as far as available – preferably in a Matlab environment).
- Application of the algorithms to the design problem.
- Comparison of the characteristics of the algorithms in the investigated application.

Objective function can be (among others): minimum take-off mass, minimum operating empty mass, minimum fuel mass, minimum DOC. *Optimization parameters* can be (among others): m_L/m_{TO}, C_{LmaxL}, C_{LmaxTO}/C_{LmaxL}, n_E, V/V_{md}, S_{wet}/S_{ref}, A, BPR and M_{CR} (see lecture notes "Aircraft Design", Chapter 5) as well as suitable cabin related parameters. Once key aircraft parameters (S_W, m_{MTO}, m_L, m_F, …) are obtained, they should be checked with PreSTo (http://PreSTo.ProfScholz.de).

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