The Mass Growth Factor - Snowball Effects in Aircraft Design

Task for the project

Background

The mass growth factor is fundamental for the preliminary design of the aircraft. It is usually defined as the ratio of an increase in total mass (take-off mass) due to an arbitrary increase in local mass (empty mass), which is determined after a complete iteration in the aircraft design to achieve the original performance requirements (payload and range). The iteration of the aircraft construction provides a further increase of the take-off mass after each loop, so that an initial (local) mass increase worsens the situation like a snowball turning into an avalanche. Hence, the pseudonym snowball effect. The concept of the mass growth factor is probably as old as aviation. It was intensively discussed from the 1950s to the 1970s and is still mentioned repeatedly today. Nevertheless, it seems not to be understood well enough today. Perhaps its importance has decreased due to modern computing power, which provides quite accurate mass estimates in every design phase, but keeps the engineer from having a feel for the numbers.

Task

The task of this project work is to determine the mass growth factor. This shall be done by using the iteration method. Furthermore an equation shall be derived, with which the mass growth factor can be calculated directly. The calculation methods shall be used to calculate mass growth factors for many of the common passenger aircraft. The following sub items shall be considered:

- Literature research: Collecting previous findings
- Derive methods for calculating the mass growth factor
- Determining the mass growth factor for passenger aircraft flying today
- Sensitivity test of the mass growth factor

The results should be documented in a report. When preparing the report, the relevant DIN standards must be observed.