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Optimization and Visualization in Passenger Aircraft Design with the Excel Solver and OpenVSP

Task for a *Bachelor Thesis*

Background

In the research project SAS (Simple Aircraft Sizing) we have developed optimization tools. All of these tools use an Evolutionary Algorithm (EA) of type Differential Evolution (DE). The Excel Solver has been used only as a local part of the global Differential Evolution. This is described in the Dissertation (PDF, 10 MB) in Chapter 6.2 and 7.3.3. The dissertation was part of OPerA. We want to find out, if we can add optimization capabilities already to a simple Aircraft Preliminary Sizing Tool (PreSTo-Classic) just with Excel's Solver. Another Excel-based aircraft design tool is RASCE which is offered on the OpenVSP Wiki. RASCE comes in four versions. We are most interested in the design tool for aircraft with turbofan engines. Excel-based aircraft design tools often encounter the difficulty of visualization. OpenVSP-Connect offers a solution for this obstacle by serving as a bridge between any aircraft design Excel tool and the visualization tool OpenVSP from NASA.

Task

This thesis should introduce optimization and visualization to simple aircraft sizing tools by using Excel's solver, OpenVSP-Connect, and OpenVSP. The detailed tasks are:

- Describe the Excel based aircraft design tool RASCE.
- Use RASCE and PreSTo-Classic to re-design an A320.
- Use OpenVSP-Connect to bridge from RASCE respectively PreSTo-Classic to OpenVSP.
- Implement the Excel Solver into RASCE.
- Implement the Excel Solver into PreSTo-Classic in various ways:
  - Find an optimum matching chart by changing cruise speed with respect to minimum drag speed, V_{CR} / V_{MD}.
  - Find V_{CR} / V_{MD} for lowest maximum takeoff mass (MTOM).
  - Find a combination of optimum matching chart and lowest MTOM by changing V_{CR} / V_{MD} and By-Pass Ratio (BPR).
  - Find the lowest MTOM by changing other parameters available in preliminary sizing.

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