FACULTY OF AVIATION AND AUTOMOTIVE SYSTEMS (LFS)

Preliminary Sizing and Optimization of Propeller Aircraft (Part 23)

The tool covers the entire spectrum of modern light-to-commuter propeller aviation with conventional propulsion. Aircraft are included from one to 21 seats (19 passengers and two pilots). Transatlantic certification frameworks are considered with EASA CS-23 Amendment 6 and FAR Part 23 (Amendment 64) together with the modern European Microlight class limited to 600 kg / 650 kg (amphibious, Figure 1).

PURPOSE

Preliminary sizing and optimization of propeller aircraft certified under EASA CS-23 Amendment 6 or FAA FAR Part 23. Considering relevant certification constraints and typical propulsion concepts for small aircraft. Integration of the method into a user interface known already from other tools being part of Simple Aircraft Sizing and Optimization (SAS) and PreSTo-Classic at HAW Hamburg.

METHODOLOGY

The tool uses the proven methodology based on the Matching Chart (power-to-mass versus wing loading), the Excel-Solver and Differential Evolution (DE). Conventional propulsion: Piston engines (Otto, Otto with Turbo Compressor, Diesel) and Turboprop engines are considered. Altitude-dependent power modelling for all engines, and extended propeller efficiency calculations for variable-pitch and fixed-pitch propellers are used. The resulting tool is evaluated with the redesign of a Cessna 172.

FINDINGS

The existing SAS and PreSTo Excel environment known from FAA FAR Part 25 (see: Poster DLRK 2024: https://doi.org/10.48441/4427.2134) was adapted to ensure continuous user experience. The user interface of the new tool "SAS-Part23-Prop" is shown in Figure 2. The tool reproduces the selected Cessna 172 reference parameters almost exactly. The redesign shows that consistent assumptions for propeller efficiency, rotational speed, field-length requirements, and validated statistical parameters are essential for obtaining plausible sizing results. A simple sizing tool "PreSTo-Classic-Part23-Prop" (Figure 3) for use in an Aircraft Design lectures is also available.

Figure 1: **The Flywhale FW650 (Uniplanes GmbH), today Dornier Seawings DS-2C, is a German two-seat amphibious sports aircraft in the 650-kg-class. More: Bachelor Thesis, Gmelin 2022, https://doi.org/10.5281/zenodo.15618552).**

RESEARCH LIMITATIONS

The results are limited by the simplified equations and statistical parameters used in preliminary sizing. No new statistical database for modern CS-23 aircraft was developed. Electric propulsion concepts are not yet included. The tool is intended for conceptual design and cannot replace detailed analysis in later design phases.

PRACTICAL IMPLICATIONS

The tool provides a structured environment for students and designers to evaluate CS-23 propeller aircraft concepts, compare manual and solver-based sizing workflows, and investigate the influence of engine and propeller concepts together with matching power-to-mass and wing loading. Highly automated aircraft preliminary sizing and optimization for new and redesign is possible (SAS-Part23-Prop). Alternatively, a simple tool for hand calculations is offered (PreSTo-Classic-Part23-Prop). The tools are designed to give users a steep learning curve.

ORIGINALITY

A didactically enhanced design, redesign, and optimization tool (on preliminary sizing level) for small propeller driven aircraft is made openly available. It is especially suited for students and fills a perceived gap.

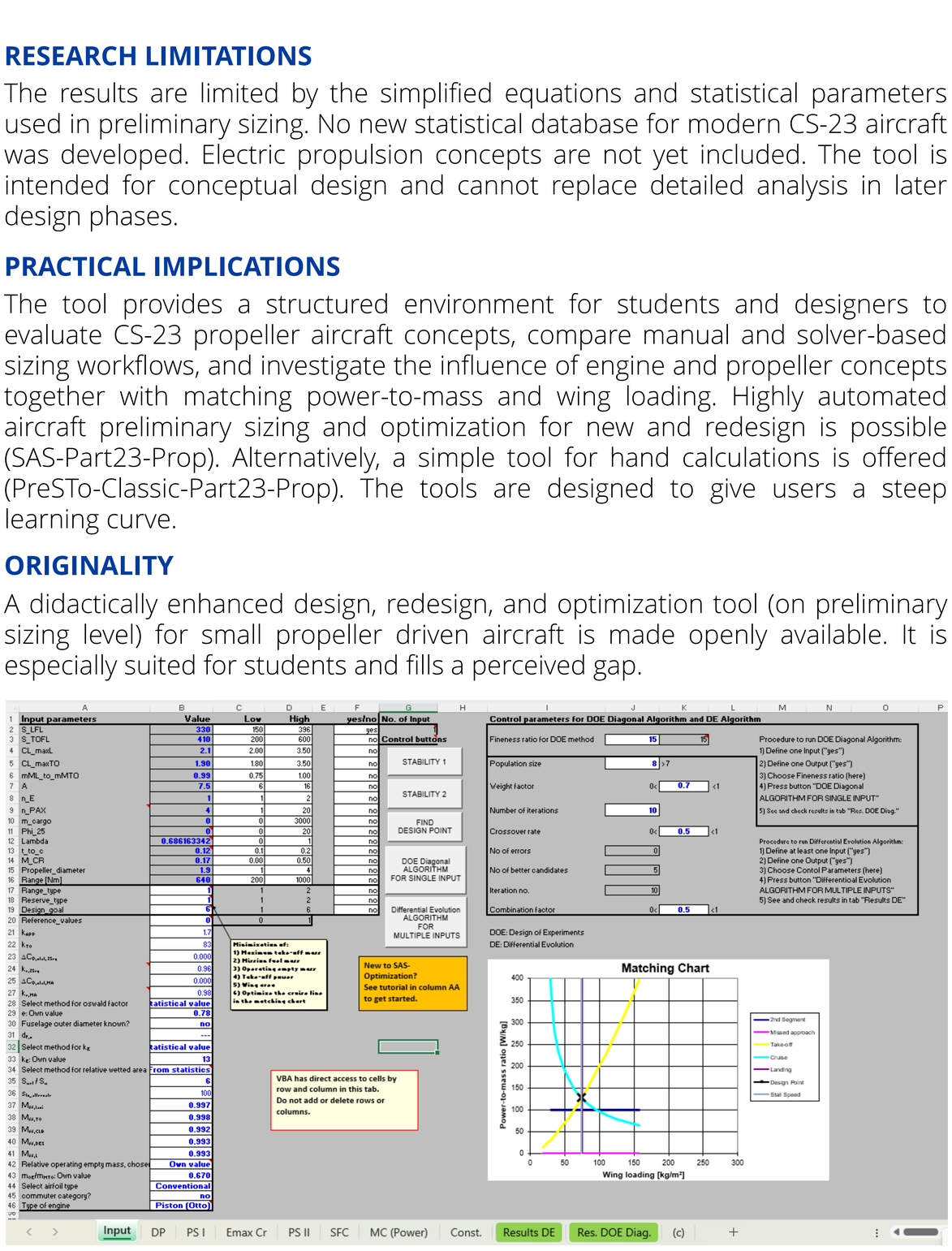

Figure 2: **Optimization: Detail of the Excel tool "SAS-Part23-Prop" (http://SAS.ProfScholz.de).**

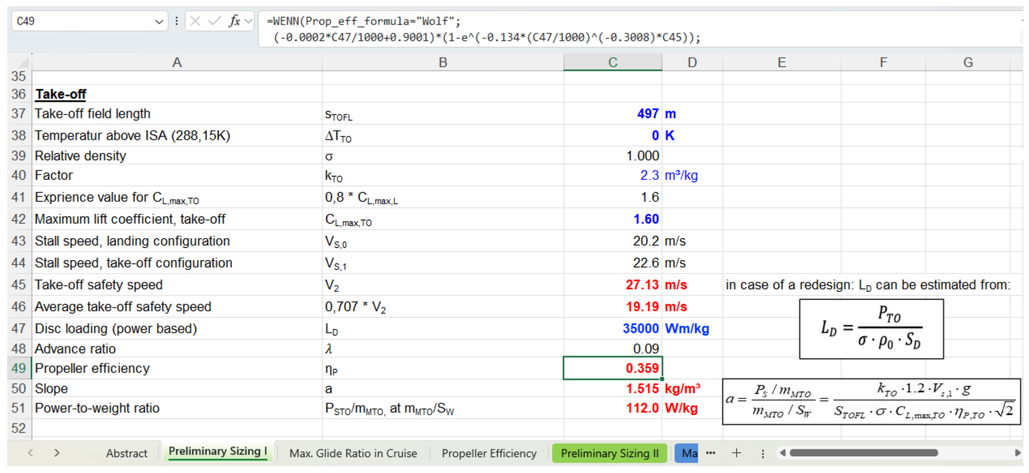

Figure 3: **Sizing: Detail of the Excel tool "PreSTo-Classic-Part23-Prop" (http://PreSTo-Classic.ProfScholz.de).**

PreSTo Classic

OpenOffice.org

All details in the Master Project of Gmelin (2026):
https://nbn-resolving.org/urn:nbn:de:gbv:18302-aero2026-04-30

Associated research data (Harvard Dataverse):
https://doi.org/10.7910/DVN/YPX9BD

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