LUKY

The E-Props Propeller Design Software

Aerodynamic, Mechanical and Manufacturing Optimization by Evolutionary Metaheuristics

Technical Note — August 2026

Introduction

A propeller is a compromise between many interdependent parameters — aerodynamic, mechanical and manufacturing — for a given engine, airframe and operating conditions.

E-Props resolves this compromise through calculation, using LUKY, its proprietary design software.

> **Scope of this note**
> This note introduces LUKY, the proprietary design software developed since 2007 by Jérémie Buiatti, and since enriched with E-Props' team of engineers. Jérémie Buiatti is the propeller designer and technical director of the company. This note explains how the software works and how it shapes every E-Props blade.

Jérémie Buiatti — Propeller Designer, Technical Director

Jérémie Buiatti is a founding partner of E-Props. He is the designer of every E-Props propeller and head of the company's Research and Development department. He has developed LUKY since 2007, and enriches it today with his team of engineers.

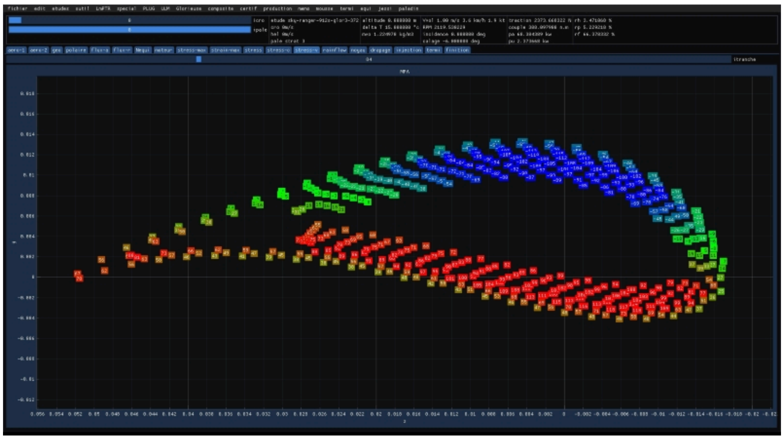
Jérémie Buiatti at his workstation, E-Props design office, Sisteron

LUKY — An Exceptional Design Software

LUKY is E-Props' proprietary aerodynamic, mechanical and manufacturing- process model of its propellers, developed since 2007 by Jérémie Buiatti, since enriched with E-Props' team of engineers, and coded in C++.

LUKY models the complete behaviour of an E-Props propeller (blades and hub) mounted on a given engine, from both an aerodynamic and a mechanical standpoint, including its vibratory behaviour and fatigue life. It couples three levels of physics:

- **Aerodynamics** — a lifting-line model, chosen for its execution speed. It is also coupled to an aerodynamic model of the free vortex wake, to verify, in extreme cases, the relevance of the lifting-line model.
- **Structural mechanics** — a Finite Element dynamic beam model with damping, simulating the blade's behaviour in bending and torsion. Coupled with the aerodynamic model, it represents stall flutter, resonance with the engine, and bird strike.
- **Fatigue life** — a Rainflow-type cycle-counting algorithm compares the resulting stresses to fatigue test data, to determine the propeller's lifetime.



Stresses in the carbon plies of a blade section

How LUKY Designs a Propeller: Evolutionary Optimization

Rather than drawing a propeller, manufacturing it and then checking whether it works, LUKY automatically explores the entire space of possible propellers for a given specification, using an evolutionary algorithm (metaheuristic). A population of candidate propellers is generated, evaluated against the aerodynamic, mechanical and fatigue models described above, and then evolves generation after generation, converging toward the solutions that best satisfy the specification.

The optimization runs simultaneously across every parameter that defines a propeller:

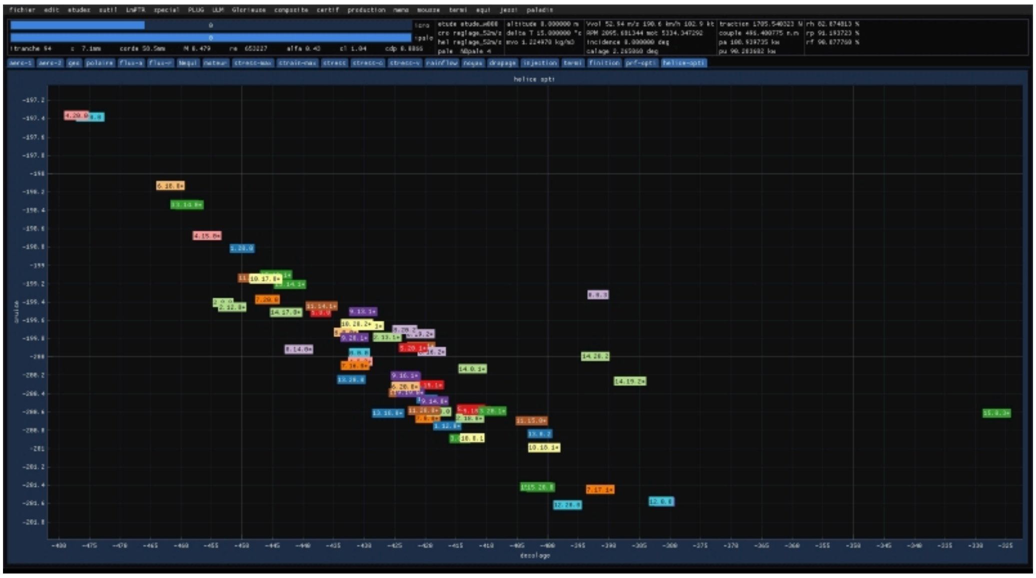
- Number of blades
- Blade loading (thrust) distribution along the span
- Chord distribution
- Pitch distribution along the span
- Airfoil selection along the span

These parameters are tightly coupled:

- increasing the number of blades reduces the thrust carried by each blade, and therefore its induced drag, but for a constant chord this increases friction drag;
- reducing the chord to compensate lowers the Reynolds number and degrades airfoil performance, while also raising mechanical strength issues.

Finding the optimum thrust distribution means taking induced drag into account: for example, the blade tip cannot generate high lift without high induced drag. Chord optimization consists of running each airfoil at its best lift/drag ratio, checking that each airfoil matches its CL, Reynolds and Mach operating conditions. Pitch distribution is used to maintain, for each airfoil, the optimum lift coefficient corresponding to the chosen thrust distribution, with the optimized chord and airfoils.

Because of this coupling, propeller design is an iterative process: changing one parameter requires re-evaluating all the others — this kind of global optimization cannot be achieved by CAD alone.



LUKY --- multi-objective evolutionary metaheuristic: population of candidate propellers during optimization

LUKY --- evolution of a candidate blade's local aerodynamic parameters (angle of attack, pitch, lift and drag coefficients) along the span, during optimization

Why this matters to aircraft manufacturers and pilots

A propeller optimized this way is not a catalogue part adapted to an engine: it is a solution calculated for a precise engine/airframe/mission combination, which comes closer to the maximum theoretical efficiency set by the propeller's diameter and the engine's power. In practice: aiming for the best possible performance, while keeping noise levels low.

Engine Coupling and Torsional Behaviour

A propeller is coupled to the powerplant, whose dynamic characteristics must be taken into account in the design.

The more information the E-Props team has about the engine concerned, the more precise the design will be. For a piston engine, the relevant data are the number of cylinders, the mass of the piston/connecting-rod assembly, the moments of inertia and torsional stiffness of the crankshaft, and the compression ratio. Where a torque damper is fitted, it is for example its angular deformation-torque response law that reveals the vibratory modes likely to occur in service, in order to assess their impact on lifetime and determine the resonances to be checked during test campaigns. LUKY can also simulate a gearbox design.

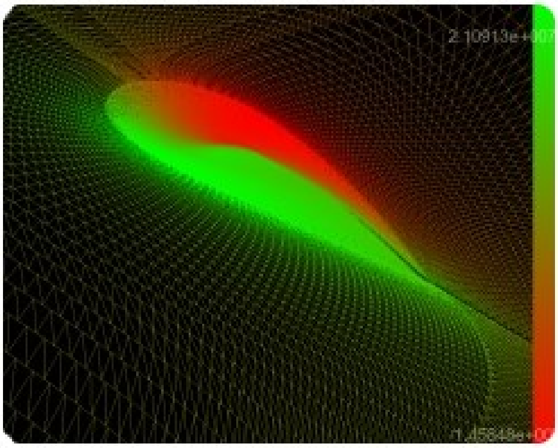
More recently, with the emergence of eVTOL configurations, LUKY has incorporated modelling of strongly oblique inflow conditions, in order to characterize their impact on the propeller and its lifetime, and to define the loads imposed on the engine in terms of torque ripple — up to a complete model of the engine support arm, engine and propeller assembly, to verify the dynamic behaviour of this assembly under oblique inflow and at different operating speeds. The same code is used to verify lateral wind loads for aircraft installations.

Structural Margins, Not Just Aerodynamic Ones

LUKY's mechanical model is coupled to the aerodynamic model within the optimization process: the propeller's sizing therefore takes aerodynamic and mechanical constraints into account simultaneously.

E-Props propellers are thus designed to be as light and as strong as possible, while aiming for the best possible performance and keeping noise levels low.

LUKY goes as far as modelling the manufacturing process itself: drawing of the mold, lamination plan and cutting program for the carbon fabric, machining program for the foam core, dimensional control scan program, and machining, drilling and grinding of the blade root.



Digital model of a blade

Conclusion

Behind every E-Props propeller stand Jérémie Buiatti, who has developed LUKY since 2007, his team of engineers who today contribute to its evolution, and this software, which combines aerodynamic and mechanical models, fatigue analysis, manufacturing-process definition functions, and evolutionary optimization.

This is what a "better propeller" means at E-Props: a propeller designed to be as light as possible, and stronger than necessary, aiming for the best possible performance while keeping noise levels low.