AURA Engineering Platform

Technical Brief v1.3

Evidence-gated workflow for aerostatic gas-bearing rotor systems

---

COMPANY Breshev Engineering
VERSION v1.3 public · June 2026
LOCATION Kyiv, Ukraine
CONTACT aura@breshevengineering.com · breshevengineering.com

Public validation registry: github.com/lfnavigator/aura-registry
Validation anchors expose residuals, lifecycle states, and applicability boundaries.

Public technical brief

What AURA is, in one paragraph

AURA is a decision-ready engineering workflow product for aerostatic and gas-static rotor systems - precision spindles, microturbomachinery, cryogenic turboexpanders, and adjacent high-speed precision rotating machinery. It couples bearing sizing, rotor-dynamic screening, stability analysis, and validation evidence into a single traceable engineering package. Where commercial CAE produces calculations, AURA produces decisions with auditable provenance: every quantitative claim - load capacity, stiffness, damping, critical-speed margin - links to a public registry entry with explicit residuals and acceptance level. Customers can inspect the public validation anchors and residual evidence in minutes; downstream documentation can cite the registry directly. Current pilots are expert-assisted engineering engagements powered by the AURA workflow; AURA is not yet a self-serve SaaS. The commercial path starts with scoped paid pilots and can transition to subscription if the pilot demonstrates fit.

The engineering problem AURA addresses

Designing or qualifying an aerostatic / gas-static bearing rotor system today typically involves three to five disconnected tools, manual handoffs between sizing and rotor-dynamic analysis, and assertion-based validation claims that downstream review cannot independently verify. The result: longer design cycles, late CAE surprises, repeated rework, and validation documentation that satisfies the customer but does not survive rigorous audit.

The downstream consequences are familiar to anyone who has shipped a precision spindle, a cryogenic turboexpander, or a microturbomachinery rotor: prototype redesigns, qualification rework, customer review friction, regulated-industry documentation deficits.

AURA closes this loop. One coupled workflow. One traceable decision package. One open registry where every claim has verifiable residual evidence.

How it works - the four-layer architecture

AURA operates as four integrated layers, each compounding the others.

LAYER 1 - Calculator (Engineering tool, paid)
Requirements -> Layout -> Bearing sizing -> Rotor-dynamic screening -> Validation registry -> Manufacturing pack

LAYER 2 - Research Mode (Parametric studies and design space)
Sweeps · operating maps · sensitivity analysis · publication-ready figures · rational design region identification

LAYER 3 - Registry (Open trust layer)
JSON Schema v1.1 · acceptance levels · lifecycle states · deterministic SHA-256 hashing · public anchor library

LAYER 4 - Knowledge Hub (Public reference)
Methodology articles · Object Card library · worked examples · physics explainers

Layer 1 is the engineering tool customers pay for. It takes a bearing/rotor architecture from requirements through manufacturing-ready output in a single coupled pipeline. Currently v0.3.0-alpha with conical aerostatic bearing analysis using the improved Breshev perturbation method.

Layer 2 turns Layer 1 from a calculator into a research instrument. Parameter sweeps generate operating maps. Sensitivity analyses identify rational design regions. The outputs become publishable research artifacts.

Layer 3 is the open trust layer. Every validation case is committed to the registry with deterministic hash, explicit residuals, acceptance level, lifecycle state, and applicability bounds. This is inspectable in minutes by anyone with a browser.

Layer 4 is the public reference library. Object Cards, methodology articles, worked examples. The substrate that makes AURA the place engineers go to understand the physics, not just calculate it.

The four layers together are what distinguishes AURA from any single-purpose CAE tool. Commercial CAE tools generally focus on Layer 1. In this specialty, we have not found a public, evidence-registry-based implementation with the same combination of coupled workflow, validation registry, methodology library, and reusable engineering knowledge base.

Validation evidence - two public engineering anchors

Two public engineering-evidence anchors are committed and verifiable today at github.com/lfnavigator/aura-registry.

Anchor 1 - Conical aerostatic bearing

Case identifier: `VCR_BRESHEV_CONICAL_P05_METHOD_CHAIN_001`

What it validates: A conical aerostatic bearing configuration in the documented Breshev family, validated via experimental measurement -> FEM reference -> AURA Perturbation Method method chain.

Verifiable residuals:

Comparison	Quantity	Worst residual
FEM vs experiment	P05 load capacity	3.938%
PM/AURA vs validated FEM	P05 axial stiffness	7.143%
PM vs FEM	P04 load capacity	7.692%

Acceptance posture: Scoped engineering-evidence anchor for preliminary screening within the documented bearing family. Not promoted to full Level B / L5 status - external multi-source triangulation pending.

Anchor 2 - Journal aerostatic bearing (L4 dual benchmark family)

Case identifier: `VCR_AURA_JOURNAL_AEROSTATIC_L4_DUAL_BENCHMARK_001`

What it validates: Aerostatic journal bearing dynamic stiffness and damping coefficient identification, validated against two independent benchmark families with explicit holdout discipline.

Two benchmark families used:

1. Kozánek et al. 2009 (Engineering Mechanics 16(3):209-220) - within-family holdout, 2 rows
2. Fleming/NASA TN D-8270, 1976 - second-source independent holdout, 2 rows

Verifiable residuals (combined L4 predicate):

Family	N holdout closed	Max abs residual	Mean abs residual
Kozánek within-family	2/2	10.282% (Cxx)	5.304%
Fleming/NASA second-source	2/2	3.680% (K)	1.718%
Combined L4	**4/4**	**10.282%**	**3.767%**

Discipline features:

- Target-echo firewall: ACTIVE (calibration row IDs and holdout row IDs strictly disjoint, leakage audit PASS)
- L4 is internal AURA validation-maturity criterion - explicitly not an external universal standard
- Higher damping residual (Cxx 10.282%) reflects physical sensitivity of damping coefficient identification, documented as expected behavior

Acceptance posture: Benchmark-scope engineering confidence for the documented benchmark families. This is not an arbitrary-geometry production release claim.

Why this matters structurally

Commercial CAE validation claims are often summarized as "validated against industry benchmarks." AURA makes the evidence inspectable: the specific benchmarks, residuals, holdout rows, and leakage-audit predicate are exposed in the registry and can be reviewed directly.

Both anchors are committed in the public registry under CC-BY-4.0 license. Schema v1.1 (JSON Schema Draft 2020-12) is published. The methodology paper is in preparation for external review and submission to a peer-reviewed journal.

What AURA does - workflow output

A typical AURA workflow output, end-to-end, produces:

Decision-ready engineering report - feasibility verdict (PASS / CONDITIONAL / FAIL), explicit rationale, requirement-by-requirement status, engineering recommendations

Structured engineering outputs:

- Bearing sizing tables (geometry, restrictor parameters, supply pressure, mass flow)
- Static stiffness matrices and load capacity
- Dynamic stiffness and damping matrices with cross-coupling status
- Campbell diagram with gyroscopic split
- Mode shapes and modal characteristics
- Critical speed identification with operating margin
- Forced response amplitude/phase at control points
- Stability classification with log decrement
- Clearance reserve factor

Validation provenance package:

- AURA methodology summary
- Applicable solver-sanity anchor references (10 Level A solver-sanity anchors at machine precision in active regression)
- Applicable engineering-evidence anchor references with residuals
- Applicability assessment for the specific configuration

Reusable input template - your case parameterized so subsequent projects in the same architecture class are screened in days rather than weeks

Internal review pack - formatted for engineering leadership review without further preparation

Engagement model

Current commercial engagements use a two-stage model: paid pilot -> optional subscription.

Stage 1 - Paid pilot (2-4 weeks)

Validates fit on a specific engineering case. Fixed-fee where appropriate, mutual success criteria, and explicit remediation if criteria are not met. These pilots are expert-assisted engineering engagements, not self-serve software licenses.

Typical pilot structure:

- Week 1 - Setup and ingestion (kickoff call, architecture data, initial layout)
- Week 2 - Sizing and rotor-dynamic screening with mid-pilot review
- Week 3 - Validation handoff, decision package, final review

Pilot deliverables:

- Decision-ready report on your specific architecture
- Reusable input template for subsequent projects at this architecture class
- Validation provenance package
- Internal review pack ready for engineering leadership

Pilot investment: Anchor range €12K-€40K for typical 2-4 week paid pilots, scoped after a 30-minute discovery call. Pricing depends on geometry class, data readiness, validation depth, delivery format, and whether a public reference case is part of the agreement. Larger enterprise or multi-architecture scopes are quoted separately.

Continuity and force-majeure handling: Breshev Engineering operates remote-first. Project inputs, reports, and decision artifacts are maintained in structured project folders with backup copies during the engagement. If force-majeure conditions interrupt delivery, the pilot is paused and either resumed, rescoped, extended, or partially refunded according to the agreed scope. Customer confidential data is not published to the public registry without explicit written approval.

Success criteria built into contract:

- Clear feasibility verdict delivered
- Repeatable input template delivered
- Validation provenance package delivered
- Internal review pack quality sufficient for engineering leadership without further AURA involvement

If criteria are not met at final review: remediation discussion (additional analysis, scope adjustment, or partial refund) before considering pilot closed.

Stage 2 - Subscription

Optional ongoing access for teams evaluating multiple cases per quarter. Subscription terms are scoped after a pilot or after a defined technical evaluation. The subscription is optional, not a contractual outcome of the pilot.

Who AURA is for

AURA fits engineering teams where these are true:

- **Bearing physics:** Aerostatic / gas-static (externally pressurized) journal, thrust, conical, or related configurations

- **Machine class:** Precision spindles, microturbomachinery, cryogenic turboexpanders, semiconductor stage drives, coordinate-measurement machine spindles, ultra-precision rotating machinery
- **Speed range:** Typically 10K-200K RPM, though wider ranges have been analyzed
- **Decision class:** Pre-CAE sizing, architecture screening, qualification documentation, validation provenance requirement
- **Engineering maturity:** Teams that already use ANSYS / MSC Adams / SolidWorks / similar - AURA complements rather than replaces existing CAE

AURA does NOT fit:

- Hydrodynamic-only bearing systems (different physics regime)
- Magnetic bearings (different physics regime; potential future partnership scope)
- General-purpose CAE replacement (use ANSYS or similar)
- Post-design qualification after architecture is frozen (AURA's value is at decision time)

Who's behind AURA

O. Breshev - founder, lead developer, technical architect. Builds the AURA platform; conducts customer engineering work directly. Mechanical engineering PhD (2013, East-Ukrainian National University); senior doctorate currently in progress (National University Kyiv Aviation Institute, target October 2027). Bridges deep mechanical engineering domain expertise with software platform development.

V. Breshev - chief scientist, co-author of methodology. 30+ years of original research on aerostatic gas-bearing rotor systems. Originator of the perturbation method core that AURA uses. Engineering connoisseurship across hundreds of validated bearing cases.

The two-generation continuity of work on the same physics is structurally rare. It is the depth asset that makes AURA's specialty differentiation difficult to reproduce quickly by general-purpose competitors.

A senior engineer addition is planned after first paid pilots close, to share pilot delivery as commercial scaling begins.

How to start

If you have a specific aerostatic gas-bearing rotor engineering decision where AURA could help - a new spindle architecture, a turboexpander rotor configuration, a microturbomachinery validation challenge - the next step is a 30-minute discovery call.

The discovery call has one purpose: figure out whether AURA actually fits your specific problem. If it does not, we say so. If it does, you receive a one-page pilot scope within 48 hours with specific objective, deliverables, success criteria, timeline, and investment.

To start: contact via breshevengineering.com or email aura@breshevengineering.com directly.

If you are earlier-stage in evaluation:

- The registry is public at github.com/lfnavigator/aura-registry. Verify anything we claim.
- The documentation site is at lfnavigator.github.io/aura-registry.

- The methodology paper draft is available on request for serious technical evaluation under reasonable confidentiality terms.
- The Strategic Compass v1.2 (internal positioning document) is available on request for serious partnership or investment discussions.

Why this matters - the broader context

Engineering validation is moving toward structured evidence architectures: explicit evidence requirements, deterministic provenance, lifecycle states, and declared limitations. This pattern is visible across adjacent fields such as software supply chains, scientific data management, regulated engineering workflows, and machine-learning documentation.

AURA applies that pattern to a narrow engineering physics regime: aerostatic gas-bearing rotor systems. The strategic claim is deliberately scoped. AURA did not invent evidence-gated registries. The claim is that, in this specialty, we have not found a public, registry-based workflow implementation that exposes validation anchors, residuals, lifecycle state, and applicability boundaries in this way.

That position can compound over the next 24-36 months if the registry accumulates more cases, the methodology is externally reviewed, and pilot engagements convert into repeatable engineering templates.

At a glance

What	Evidence-gated engineering workflow product for aerostatic / gas-static rotor systems
Physics scope	Aerostatic journal, thrust, conical bearings; applications include spindles, microturbomachinery, cryogenic systems, and ultra-precision rotating machinery
Validation status	Two public engineering-evidence anchors live · Schema v1.1 · 10 Level A solver-sanity anchors at machine precision
Recent residuals	Conical: 3.938% / 7.143% / 7.692% · Journal: max 10.282% / mean 3.767% across 4 holdout rows · Leakage audit PASS
Methodology	Breshev perturbation method · Method-chain validation · Target-echo firewall · L4 dual benchmark-family criterion
Engagement model	Paid pilot (2-4 weeks, anchor range €12K-€40K) -> optional subscription
Continuity	Remote-first delivery · structured project folders · backup copies during engagement · force-majeure pause/rescope/refund handling
License posture	Methodology + Schema CC-BY-4.0 · Platform software commercially licensed
Founders	O. Breshev (founder, lead dev) · V. Breshev (chief scientist, 30+ years specialty research)
Location	Kyiv, Ukraine; international remote engagement standard
Contact	aura@breshevengineering.com · breshevengineering.com

A note on first-mover positioning

AURA's registry, schema, and four-layer architecture were developed in 2025-2026. Adjacent evidence-governance patterns emerged independently in other domains. AURA did not invent the broader pattern.

The first-mover claim should be read narrowly: in the specific specialty of aerostatic gas-bearing rotor systems, we have not found a public competing implementation that combines a workflow product with an auditable validation registry, residual-level anchors, lifecycle states, and explicit applicability boundaries.

The practical objective is to build reference-platform status through accumulated cases, schemas, worked examples, and repeatable pilot templates. This is a compounding strategy, not a claim of universal market ownership.

If your team is working in this physics specialty, AURA is available today for scoped technical evaluation. If you are working in an adjacent specialty, the same evidence-gated architecture may still be relevant.

Document control. v1.3 public, June 2026. License: CC-BY-4.0 (this brief). Author: O. Breshev. For deeper materials including the methodology paper draft, Strategic Compass v1.2 (internal positioning), Object Card Schema v1.0, or detailed Pilot Scoping Framework, contact aura@breshevengineering.com.

Verify the claims directly. The registry is at github.com/lfnavigator/aura-registry. Two public anchors are available for inspection.