Paper 026 / Application 003

AtlasForge: A Differentiable FEM Service for Anomaly-Resistant Apparatus Design

Geometry scoring, artifact amplification, and reproducible simulation pipelines in JMP0X1B

JMP0X1B Research Group

Working paper draft / June 13, 2026

Abstract

AtlasForge is a proposed simulation service that implements the finite-element and geometry-search papers. Its purpose is to design apparatus that separates mechanisms under controls and to publish the failed designs that reveal artifact traps. AtlasForge manages CAD digests, mesh convergence, solver settings, proxy calculations, surrogate models, and discrimination scores.

Status. Draft manuscript for review and revision. This paper is not an empirical claim of new physics or field-ready technology. It is a structured proposal, theory note, protocol, or application architecture intended to be auditable, falsifiable, and publishable with source.

Contents

1 Problem

Simulation artifacts can be as misleading as laboratory artifacts. If geometry search is not reproducible, a high-scoring design may reflect mesh tags, solver tolerance, or hidden objective tuning. The problem is to create a service where simulation results are signed, replayable, and tied to a declared discrimination objective.

2 Model

AtlasForge is built as a pipeline: geometry source, mesh, material map, field solve, proxy extraction, signature scoring, robust perturbation, and reviewer report. Every stage is an artifact with digest, version, and effect label.

$$G \xrightarrow{mesh} M \xrightarrow{solve} \Phi, E \xrightarrow{proxy} z \xrightarrow{score} D(G).$$

$$\mathrm{Valid}(G) = \mathrm{Converged}(M) \wedge \mathrm{UnitsOK}(z) \wedge \mathrm{ObjectiveDeclared}.$$

3 Claims

1. **Claim 1.** A geometry-scoring service must publish convergence failures as first-class results.
2. **Claim 2.** Artifact amplifiers are useful outputs because they calibrate what the experiment should be able to reject.
3. **Claim 3.** Typed simulation manifests reduce ambiguity between physics assumptions and numerical settings.
4. **Claim 4.** AtlasForge provides a technology bridge from frontier-physics tests to ordinary high-voltage design and sensor packaging.

4 Evidence Plan

Initial evidence is a benchmark suite of canonical capacitors with known symmetries. The service must reproduce symmetry nulls, identify edge-dominant proxies, and flag unstable mesh-dependent scores. A second benchmark searches a constrained design family and compares results against hand-designed baselines.

5 JMP0X1B Implementation Surface

JMP0X1B actors should wrap solver backends, geometry validators, artifact stores, and scoring functions. Effects identify non-deterministic external solvers, while manifests pin versions and tolerances.

Illustrative JMP0X1B-style contract

```
actor FEMBackend {
    fn solve(mesh: MeshDigest, physics: PhysicsSpec) -> FieldSolution effects{ExternalSolver, U
}
fn score(solution: FieldSolution, controls: ControlSet) -> DesignScore effects{Deterministic, A
```

6 Release And Review Plan

Release benchmark geometries, solver manifests, comparison reports, and an API contract for adding new proxy mechanisms.

7 Open Questions

- Which FEM backend should be the reference implementation?
- How should surrogate model uncertainty be certified?
- Can topology manifests be generated automatically from CAD?
- How should proprietary geometries publish partial evidence?

8 Conclusion

AtlasForge makes simulation a reviewable part of the paper rather than an opaque prelude. That discipline is useful for anomaly tests and mainstream engineering alike.

References

References

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