Paper 035 / Application 012

AssuranceForge: Evidence Compilers for Space-Grade Quality, Compliance, and Research Translation

Connecting requirements, tests, ledgers, provenance, and publication artifacts in JMP0X1B

JMP0X1B Research Group

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Abstract

AssuranceForge is a proposed evidence compiler for teams moving from research prototypes to space-grade technology. It connects requirements, hazards, tests, simulations, supplier records, calibration files, null ledgers, software releases, and publication artifacts. The goal is to make compliance evidence a natural byproduct of disciplined engineering rather than a separate paperwork phase.

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 **2**

2 Model **2**

3 Claims **2**

4 Evidence Plan **2**

5 JMP0X1B Implementation Surface **2**

6 Release And Review Plan **3**

7 Open Questions **3**

8 Conclusion **3**

1 Problem

Research outputs often die before engineering translation because evidence is scattered. Compliance and mission assurance frameworks require traceability, configuration control, supplier data, verification, validation, and nonconformance handling. The problem is to compile evidence from research artifacts without distorting the scientific record.

2 Model

AssuranceForge represents claims, requirements, tests, hazards, artifacts, and sign-offs as typed nodes in a trace graph. Each edge states the relationship: satisfies, verifies, falsifies, supersedes, mitigates, or blocks. The compiler emits audit packs for reviewers, customers, or internal gates.

$$\mathcal{T} = (V, E), \qquad E \subset V \times R \times V,$$

where R is the relation vocabulary for traceability.

$$\text{GatePass} = \bigwedge_i \text{Evidence}(req_i) \wedge \bigwedge_j \text{Mitigated}(hazard_j).$$

3 Claims

1. **Claim 1.** Research artifacts can be compiled into assurance evidence if provenance and claim boundaries are preserved.
2. **Claim 2.** Null results and failed tests should become traceable risk reductions or design constraints.
3. **Claim 3.** An evidence compiler reduces the gap between speculative research, practical subsystem development, and regulated aerospace processes.
4. **Claim 4.** JMP0X1B typed contracts can make assurance data machine-checkable without removing human review.

4 Evidence Plan

The prototype should compile an audit pack for a cryogenic subsystem trade, a digital-twin validation run, and a laboratory null experiment. Reviewers should be able to trace every top-level claim to source artifacts or mark it unsupported.

5 JMP0X1B Implementation Surface

JMP0X1B packages for requirements traceability, compliance evidence, provenance, risk registers, supplier trace, and document control form the natural implementation base.

Illustrative JMP0X1B-style contract

```
record TraceEdge { from: ArtifactId, relation: Relation, to: ArtifactId, evidence: Digest }
fn compile_audit_pack(graph: TraceGraph, gate: AssuranceGate) -> AuditPack effects{Traceabilit
```

6 Release And Review Plan

Release trace schemas, example audit packs, relation vocabulary, and a comparison between paper claims and assurance claims.

7 Open Questions

- Which assurance framework should be the first target profile?
- How should speculative claims be labeled so they cannot leak into engineering requirements?
- Can supplier data be summarized while preserving audit usefulness?
- What human review workflow is required for high-stakes gates?

8 Conclusion

AssuranceForge is the bridge from research.jmp0x1b.com papers to deployable technology. It preserves scientific humility while preparing evidence for serious engineering.

References

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