Paper 038
Finite-Difference and Retarded-Potential Solvers for Gravity-Cogravity Fields

A computational proposal for mass-current source ledgers, causal kernels, and benchmark geometries

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Abstract

This proposal specifies a computational solver for Jefimenko-style gravity/cogravity. The solver evaluates retarded potentials and direct Jefimenko integrals from mass-current source histories, records continuity and gauge residuals, and exports parity-aware signatures for experiments and observational fits. The paper argues that solver metadata - retarded interpolation, mesh convergence, singular-cell rules, and residual gates - is part of the scientific claim. A first benchmark suite is proposed for static spheres, rotating rings, mass-current pulses, and binary toy models.

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

Analytic examples are not enough for a research program. A cogravity proposal needs an auditable solver that can compute fields from arbitrary mass-current histories, quantify residuals, and export the predicted signatures used by experiments and observational fits. The problem is to define a solver architecture that is causal, conservative, and difficult to fool.

The solver is not an engine for creating anomalies. It is an error-accounting tool. Its first job is to fail loudly when a source violates continuity or when a numerical shortcut has replaced retarded propagation with instantaneous action.

2 Model

Discretize the source into cells a with volume V_a, position $\mathbf{x}'_a$, mass density $\rho_a(t)$, and mass current $\mathbf{J}_a(t)$. For an observation node i at $\mathbf{x}_i$ and time t_n, define

$$R_{ia} = |\mathbf{x}_i - \mathbf{x}'_a|, \qquad t^{ia}_{\mathrm{r},n} = t_n - R_{ia}/c. \tag{1}$$

The retarded potential sums are

$$\Phi^n_i = -G \sum_a V_a \frac{\rho_a(t^{ia}_{\mathrm{r},n})}{R_{ia}}, \tag{2}$$

$$\mathbf{A}^n_i = -\frac{G}{c^2} \sum_a V_a \frac{\mathbf{J}_a(t^{ia}_{\mathrm{r},n})}{R_{ia}}. \tag{3}$$

Fields may be obtained either by differentiating $(\Phi, \mathbf{A})$ on the observation mesh or by direct quadrature of the Jefimenko integrals. The first route tests gauge and derivative consistency; the second route is useful for sparse detector points.

A solver state should carry residuals:

$$\epsilon_{\mathrm{cont}} = \frac{\|\partial_t \rho + \nabla \cdot \mathbf{J}\|_2}{\|\partial_t \rho\|_2 + \|\nabla \cdot \mathbf{J}\|_2 + \varepsilon}, \tag{4}$$

$$\epsilon_{\mathrm{gauge}} = \left\| \nabla \cdot \mathbf{A} + c^{-2} \partial_t \Phi \right\|_2, \tag{5}$$

$$\epsilon_{\mathrm{field}} = \sum_{j=1}^{4} w_j \epsilon_j, \tag{6}$$

where ϵ_j are the four field-equation residuals and ε is a small scale guard. No predicted anomaly should be exported if the residual gate fails.

3 Claims

Claim 1 (Retarded interpolation is a scientific assumption)**.** *The interpolation used to evaluate $\rho(t_{\mathrm{r}})$ and $\mathbf{J}(t_{\mathrm{r}})$ is part of the model. Linear, spline, spectral, or event-based interpolation can produce different high-frequency fields. The solver must publish interpolation metadata.*

Claim 2 (Continuity-preserving sources are better than corrected sources)**.** *Whenever possible, source histories should be generated from variables that satisfy continuity by construction, such as particles, incompressible flow maps, or finite-volume fluxes. Projecting a bad source onto a conserved source can hide the error that an experiment actually needs to know.*

Claim 3 (Two field paths are required)**.** *The solver should implement both potential differentiation and direct retarded-field quadrature. Agreement between the two paths is a strong internal check; disagreement is an error signal rather than a tunable parameter.*

Claim 4 (The first benchmark suite should be boring)**.** *The benchmark suite should start with a static sphere, a moving compact blob, a rotating ring, and a binary toy source. A solver that cannot reproduce simple cases should not be trusted on exotic apparatus geometries.*

4 Evidence Plan

The release should provide four benchmark families.

Newtonian sphere. A static uniform sphere tests Gauss behavior inside and outside the source. Outside the sphere, $\mathbf{g} = -GM\mathbf{r}/r^3$ and $\mathbf{K} = 0$.

Steady rotor. A rigid rotating sphere or ring tests cogravity dipole scaling and parity under angular-velocity reversal.

Mass-current pulse. A compact source with time-dependent current tests retardation and cogravitational induction.

Binary toy model. Two point-like masses on prescribed circular orbits test phase lag, source interpolation, and far-zone behavior.

Each benchmark should be run under mesh refinement. The publication should include convergence plots for ϵ_{cont}, ϵ_{gauge}, and ϵ_{field}, plus a field-energy ledger integrated over a finite domain.

5 JMP0X1B Implementation Surface

The solver belongs naturally beside AtlasForge and digital-twin tooling. A minimal interface is

```
record SourceHistory { cells, rho(t), J(t), continuity_certificate }
record RetardedKernel { c, interpolation, singular_rule }
record FieldSolution  { Phi, A, g, K, residuals, provenance }
fn solve(source, detector_grid, kernel) -> FieldSolution
fn export_signature(solution, controls) -> SignatureLedger
```

The solver should emit a signed digest of source files, mesh files, solver version, constants, and residual thresholds.

6 Release and Review Plan

Release the LaTeX proposal, a small reference implementation, benchmark source files, and a manifest that records constants and residual gates. The first implementation can be slow and transparent. Optimized kernels are secondary to auditability.

7 Open Questions

- What singular-cell rule is least misleading for compact high-density sources?
- Can finite-volume continuity certificates be made simple enough for apparatus designers?
- Which reduced-order models preserve cogravity parity without solving full retarded integrals?
- How should gravitational self-interaction be excluded or approximated in a linear solver?

8 Conclusion

This paper turns one part of the gravity/cogravity idea into a named, reviewable work package. Its value does not depend on treating the framework as established physics. The value is the disciplined reduction of a speculative field analogy into equations, invariants, bounds, null tests, and release artifacts that can be audited and either extended or killed.

References

References

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