Algorithmic Hysteresis Primacy (AHP): Temporal Sovereignty in AI Governance

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Abstract

This article advances a critical intervention in Science and Technology Studies by examining temporal design as a site of political struggle in algorithmic governance. Working within the tradition of critical technical practice—and responding to recent calls for its pluralisation—we develop Algorithmic Hysteresis Primacy (AHP) as a conceptual framework that introduces synthetic inertia into computational systems: architectural resistance to acceleration that creates mandatory cognitive buffering intervals for human deliberation.

Against the pervasive acceleration imperative that equates speed with optimization, AHP makes visible how speed functions as a form of power, and how constitutive hesitation can reconfigure spaces for contestation and oversight. The framework operates through provocative specifications—formal specifications, protocol grammars, and mathematically guaranteed delays—that translate ethical discourse into architecturally legible forms without claiming empirical validation. Through conceptual analysis of paradigmatic failures and contemporary welfare systems in the Global South, we demonstrate how temporal pathologies emerge when systems operate faster than human comprehension, regulatory intervention, or democratic contestation. AHP serves primarily as a diagnostic tool for revealing temporal asymmetries in global technological systems, particularly from peripheral epistemic locations where speed often operates as imposed temporality.

The framework is situated within a pluriversal landscape of temporal epistemologies. We engage with recent articulations of AI sovereignty from Africa, Latin America, and Asia. These dialogues demonstrate that the search for temporal sovereignty is not a peripheral idiosyncrasy but an emergent Global South political consensus demanding architectural expression.

This contributes to STS debates on infrastructural politics by demonstrating how time itself can be designed as territory of governance and resistance, and advances critical technical practice by showing how technical specification can materialize political critique without solutionist pretensions. We explicitly address the framework's ambivalences: between critique and solution, between universal

and particular temporalities, between technocratic expertise and democratic participation.

Keywords: Critical technical practice · Algorithmic governance · Synthetic inertia · Cognitive buffering · Temporal politics · Hysteresis control · Decolonial STS · Cosmotechnics · Participatory design · Temporal sovereignty

1 Introduction: Temporal Design as Political Terrain

Contemporary digital infrastructures operate under an *acceleration imperative*—latency minimization as synonym for progress. This article constitutes a conceptual intervention at the intersection of STS, philosophy of technology, and critical design practice. We treat algorithmic systems as *social institutions* where temporal arrangements encode political relationships and redistribute agency (Winner, 1980; Latour, 1992).

Our central provocation: What happens when we design systems to hesitate by default? Modern computational infrastructures possess extensive mechanisms for acceleration yet lack architectural primitives for deliberation. This omission is a political choice materialized in silicon and code.

1.1 Positioning: Conceptual Engineering as STS Practice

We engage in *conceptual engineering within STS*—articulating normative critiques through technically-informed design vocabularies (Akrich, 1992; Jasanoff, 2004). We develop Algorithmic Hysteresis Primacy (AHP) as a *critical design framework*.

Crucial disclaimer: This work is conceptual infrastructure for political analysis, not empirical validation. Our contribution is **diagnostic**. It emerges from Northeastern Brazil—where technological infrastructures are often experienced as *imposed temporalities*.

1.2 Methodological Heritage: Critical Technical Practice and Its Pluralisation

This work is situated within **Critical Technical Practice (CTP)** (Agre, 1997). CTP moves beyond criticism to construct technical artifacts that materially embody social critique.

Responding to calls to *pluralise* CTP beyond its reformist origins (van Geenen et al., 2024), we position AHP as **situated practice from the periphery**. It is practiced not from MIT or PARC, but from Jardim do Seridó, RN, Brazil—where acceleration is experienced as imposition. Its tools are open specifications, public datasets, deliberately

Supplementary materials (proofs, protocols, code) at https://zmem.org. Self-contained article.

un-validated protocols. Its constructive moment is the *provocative specification*: a formally executable artifact demonstrating the architectural possibility of hesitation without claiming deployment readiness.

AHP aligns with extensions into reflexive data science (Hirsbrunner et al., 2024), grassroots innovation (Sipos, 2025), and contestation as practice (Hirsbrunner et al., 2025). It heeds the caution against *cynical* practice (Hind and Seitz, 2024); our refusal to position AHP as solution is defense against cynical incorporation.

1.3 Methodological Approach: AI-Augmented Conceptual Engineering

We demonstrate **AI-Augmented Conceptual Engineering via Synthetic Consensus**. The philosophical critique originates from the human author; translation into control theory, formal mathematics, and code is AI-assisted. This embodies *reflexive data science* (Hirsbrunner et al., 2024): alternating between programming and discursive reflection.

Our iterative protocol: (1) Conceptual iteration (human → LLM), (2) Multi-agent critique (diverse LLMs tasked with identifying inconsistencies), (3) Refinement until convergence. The resulting formalizations are **AI-generated proposals curated by the human author**. We present them as *provocative specifications*—rigorous enough to be debated, intended to demonstrate *architectural possibility*.

This aligns with AI & Society's interest in "methodological orientations of ongoing research" (AI & Society Journal, 2025).

1.4 Synthetic Inertia and Cognitive Buffering

Synthetic inertia: Architectural resistance to acceleration via hysteresis bands and accumulation limits. Not inefficiency but *deliberative infrastructure*.

Cognitive buffering: Temporal windows ($\Delta T_{\min}$ intervals) created by synthetic inertia—preserves for neurophysiological deliberation, regulatory review, democratic contestation.

Together they operationalize **temporal sovereignty**: capacity to determine one's own temporal rhythms rather than having speed imposed.

1.5 The Speed–Responsibility Paradox

Algorithmic systems achieve efficiency by eliminating temporal intervals where responsibility can be meaningfully exercised. When decisions occur faster than neurophysiological awareness, they cease to be *decisions* in any ethically significant sense. Acceleration functions as *political delegation*.

Table 1: Core conceptual innovations: from physical analogies through digital implementation to political function. Synthetic inertia materializes as architectural mass; cognitive buffering as guaranteed deliberation windows; temporal sovereignty as self-determination of rhythm.

Physical Analogy	Digital Implementation (AHP)	Political Function
Mass/Inertia	Synthetic inertia via hysteresis band ($\Gamma_{\max} - \Gamma_{\min}$)	Architectural resistance to acceleration; prevents instantaneous state changes
Temporal buffer	Cognitive buffering via $\Delta T_{\min} > 0$ intervals	Preserves neurophysiological deliberation windows; enables meaningful oversight
Territorial sovereignty	Temporal sovereignty via design-time control over $\Delta T_{\min}$	Capacity for self-determination of temporal rhythms against imposed acceleration

1.6 Scope and Epistemological Boundaries

AHP operates as **provocative specification**—a hybrid genre: maintains political potency of technical materialization, refuses direct instrumental functionality, invites contestation through concreteness.

- **Not a technical solution:** Conceptual framework for analysis.
- **Not culturally universal:** Temporal values are contested.
- **Not conflict resolution:** Makes conflicts architecturally visible.
- **Not empirical validation:** Conceptual work; empirical studies are separate.

Remark 1.1 (Against Solutionism). AHP does not solve ethical problems but reconfigures spaces where they become debatable. Following Hind and Seitz (2024), we resist cynical incorporation by remaining at provocative specification—precisely specified, formally executable, deliberately un-validated.

1.7 Epistemic Positionality

This research emerges from Northeastern Brazil—peripheral to global innovation hubs. This positioning is constitutive: from peripheral contexts, infrastructures are experienced as imposed temporalities. The acceleration imperative operates as geopolitical force.

We claim *strong objectivity* (Harding, 1991): peripheral positions reveal dynamics invisible from centers. Yet we resist romanticizing the periphery; it enables particular questions while obscuring others. Sipos (2025) demonstrates that peripheral CTP generates distinct practices not evaluable by Northern metrics.

2 Algorithmic Hysteresis Primacy: Formalization as Political Vocabulary

We approach formalization as **political vocabulary-making**. Mathematics as *grammar of critique*, translating normative concerns into architecturally legible forms (Jasanoff, 2004; Agre, 1997).

2.1 Three Levels of Formalization

Level 1: Mathematical notation as boundary object (Star and Griesemer, 1989)—symbols (Γ, Φ, γ) as translation between ethical discourse and technical practice.

Level 2: Architectural properties as political commitments—Non-Zeno property as formalized guarantee that certain temporal conditions are architecturally impossible.

Level 3: Executable specifications as proofs of possibility—Code demonstrates *implementability*, not universal deployability.

Remark 2.1 (Against Formalization). Mathematics can function as *technology of closure*. We resist by: (1) framing mathematics as "political vocabulary-making", (2) providing conceptual definitions, (3) including this reflexive moment.

2.2 Mathematics as Boundary Object

$$I(t) = \int_{t_0}^{t} \phi(\tau)\, d\tau, \quad 0 \leq I(t) \leq I_{\max}$$

$\phi(t)$: incoming signals as sociotechnical constructs; $I_{\max}$: threshold for actionability embodying epistemic standards.

$$\Delta T_{\min} = \frac{\Gamma_{\max} - \Gamma_{\min}}{\Phi_{\max}}$$

Encodes *political decisions*: $(\Gamma_{\max} - \Gamma_{\min})$ = socially negotiated certainty; $\Phi_{\max}$ = governance-imposed limits on speed.

Key Terminology (Conceptual, not technical):

$\Delta T_{\min}$	Minimum hesitation interval; institutionalized thinking-time.
$\Gamma_{\min}, \Gamma_{\max}$	Decision thresholds; deliberation zone.
$\Phi_{\max}$	Governance cap; some decisions should not be made too quickly.
γ	Conviction metric; progress toward commitment.

2.3 Hysteresis as Political Primitive

Hysteresis prevents systems from acting on momentary impulses—*architectural expression of deliberative values* (Santoni de Sio and van den Hoven, 2018).

2.4 Synthetic Inertia & Cognitive Buffering

Synthetic inertia = architectural "mass" via ($\Gamma_{\max} - \Gamma_{\min}$). Wider band = greater resistance. Decision speed becomes design variable, not optimization target.

Cognitive buffering: $\Delta T_{\min}$ intervals as ethical infrastructure—neurophysiological (100–300 ms), regulatory (seconds–minutes), democratic (hours–days).

Principle 2.1 (Cognitive Buffering)**.** *For consequential decision systems, architecturally guaranteed* $\Delta T_{\min} > 0$ *where actions remain reversible and contestable. Magnitude reflects ethical stakes.*

2.5 Architectural Non-Zeno Property

$$\Delta T_{\min} = \frac{\Gamma_{\max} - \Gamma_{\min}}{\Phi_{\max}} > 0$$

Political reading: Consequential decisions should not occur faster than deliberation. This is structural guarantee, not policy aspiration. Unlike speed limits (exceedable) or throttles (bypassable), Non-Zeno is enforced by state machine topology.

Falsifiable: Measured $\Delta T < \Delta T_{\min}$ constitutes protocol violation. Temporal governance becomes auditable.

2.6 Participatory Calibration: Democratizing $\Delta T_{\min}$

Risk of **technocratic ethics**—translation of rights claims into parameters transferring power from democratic deliberation to experts.

Four-Phase Protocol: 1. Ontological Mapping (community temporal values) 2. Rights Translation (e.g., "prior consultation" $\rightarrow \Delta T_{\min}$ of days) 3. Community Validation (architectural informed consent) 4. Contingency (periodic review)

Okolo (2025): *no-code AI governance* enables communities to specify parameters. AHP translates this into temporal register.

Remark 2.2 (When Refusal is Preferable). Some decisions should not be automated regardless of hesitation. Predictive policing may violate rights even with $\Delta T_{\min} = \infty$.

2.7 Architectural Translation of Postcolonial Principles

Ghoshal et al. (2025): four principles for postcolonial AI governance find architectural expression in AHP:

- **Epistemic non-imposition**: Refusal of universal $\Delta T_{\min}$; local determination.
- **Onto-contextual consistency**: $\Delta T_{\min}$ reflects actual community rhythms.
- **Agentic boundaries**: Non-Zeno guarantees veto window.
- **Embodied spatial justice**: Temporal sovereignty over algorithmic decisions affecting territories.

3 Plural Temporal Epistemologies: Beyond Western Universalism

3.1 Colonial Genealogy of Western Calibrations

Table 2: Critical genealogy of $\Delta T_{\min}$ calibrations

Domain	Colonial Context	Cultural Assumptions
HFT	SEC as post-1929 institution	Individual trader agency; market efficiency supreme
BMI	Western neuroscience on Western subjects	Individualist agency; Cartesian mind/body
Smart Grid	UK infrastructure as colonial legacy	State centralization
Medical AI	GDPR as European context	Western individual privacy

This *provincializes* (Chakrabarty, 2000), not invalidates.

3.2 Non-Western Temporal Epistemologies

Chukwuere et al. (2024): decolonizing AI governance requires African epistemologies as generative of distinct temporalities. Adamu (2026): *algorithmic dependence*—Global South constrained to Northern temporal rhythms. Effoduh (2025): decoloniality as *modest germinations*—hesitations, pauses, recalibrations. Gwagwa (2024): hesitation as right to refuse velocity of marginalization.

Ubuntu (Southern Africa)

Mhlambi (2020): relational temporality. $\Delta T_{\min}$ for community consultation, not individual veto.

> "Africa must write its own digital story—with African data, African rules, and African values" (Pan-African Parliament, 2026).

AHP provides grammar for this authorship: to write is to inscribe tempo.

Sumak Kawsay/Buen Vivir (Andes)

Escobar (2018): circular, intergenerational, anti-mercantile temporality. $\Delta T_{\min}$ variable according to natural cycles. Latam-GPT (Brookings Institution, 2025) learns Quechua morphology but not Quechua deliberative temporalities. AHP offers sovereignty over *when* it acts.

Indigenous Temporalities

de la Cadena (2015): extended kinship with non-humans. Hesitation for *listening*—to territory, ancestors.

Vasudhaiva Kutumbakam (India)

Collective calibration; inter-community dialogue. India's approach (Hladikova and Mehrotra, 2025) offers precedent but also risk of technocratic capture without participatory protocols.

Asian Pluralism

Zheng and Wang (2025): ASEAN-China cooperation acknowledges *multispeed development*. Uniform acceleration neither feasible nor desirable.

3.3 Toward Cultural Translation, Not Prescription

These are invitations, not conclusions. Our aim is to open space within technical discourse for plural temporal imaginaries.

3.4 Cosmotechnics of Hesitation

Hui (2016, 2021, 2025): technology embeds cosmology. The hysteresis band is a **cosmotechnical interface**. Wu wei (non-forcible action) as hesitation architecturally encoded. AHP contributes to *technodiversity*.

4 Case Analyses: AHP as Diagnostic Lens

4.1 Financial Markets: Flash Crash 2010

Kirilenko et al. (2017); U.S. Securities and Exchange Commission and Commodity Futures Trading Commission (2010). $\Delta T_{\min} \approx 0$ enabled microsecond feedback loops invisible to human oversight. With $\Delta T_{\min} = 50\,\text{ms}$: cognitive buffer for supervisory veto. Not "prevention" but making failure politically legible.

Table 3: AHP diagnosing temporal politics

Case	Temporal Pathology	AHP Reading	STS Concept
Flash Crash 2010	Microsecond sync	Politics of speed	Artifacts have politics
BrainGate Trials	Compressed intentionality	Agency delegation	Scripts of use
UK Grid 2019	Speed as fragility	Oversight gaps	Infrastructure politics
CadÚnico (Brazil)	Algorithmic exclusion velocity	Colonial temporalities	Techno-colonialism
Aadhaar (India)	Biometric speed vs. precarity	Infrastructural violence	Infrastructural inversion
Huduma Namba (Kenya)	Registration speed vs. citizenship	Racialized temporality	Biometric governance

4.2 Brain-Machine Interfaces

Libet et al. (1983); Haggard and Eimer (1999); Hochberg et al. (2012); Nicolelis (2001). $\Delta T_{\min} \geq 100$–$150\,\text{ms}$ preserves neurophysiological veto window. Architectural commitment to agency, not metaphysical claim.

4.3 Power Grid: UK 2019

Energy Networks Association (2020). Protection systems operated "correctly but too rapidly" (1–5 ms). $\Delta T_{\min} = 500$–$2000\,\text{ms}$: transient discrimination, operator intervention. Political trade-off encoded.

4.4 Welfare Systems in the Global South

CadÚnico (Brazil) (Araújo et al., 2021): Exclusion in seconds, contestation in months. Colonial temporal asymmetry.

Aadhaar (India) (Ramanathan, 2020): $\Delta T_{\min} \approx 0$ for authentication in precarious infrastructure. Structural violence.

Huduma Namba (Kenya) (Maina, 2019): Speed differentially applied—racialized temporality. Hesitation must be equitable.

5 Temporal Sovereignty: From Architecture to Political Critique

5.1 Sovereignty as Infrastructural Capacity

Temporal sovereignty = infrastructural capacity for temporal self-determination against imposed speed (Escobar, 2018).

Korea's Framework Act mandates "human-centered" AI but lacks temporal parameters. Without $\Delta T_{\min} > 0$, principles remain symbolic. TBI & WEF reports (Tony Blair

Institute for Global Change, 2026; World Economic Forum, 2026) diagnose sovereignty loss but lack architectural vocabulary. AHP provides $\Delta T_{\min} > 0$ as concrete primitive.

Waisbich et al. (2025): *rebirth of the Global South* as assertion of autonomous developmental imaginaries. Temporal sovereignty refuses teleology of "catching up".

Aruleswaran (2026): *relational sovereignty*—capacity to negotiate interdependence. $\Delta T_{\min}$ as negotiable interface.

5.2 Global South Consensus, Architecturally Expressed

The declarations and projects cited in Section 3 are not merely discursive; they constitute an emergent political consensus that the capacity to govern algorithmic time is a non-negotiable component of postcolonial sovereignty. Each articulates a distinct demand that AHP renders architecturally legible.

The Pan-African Parliament's call for Africa to "write its own digital story" (Pan-African Parliament, 2026) finds material correlate in $\Delta T_{\min}$ calibrated to Ubuntu's relational deliberation—hesitation measured not in milliseconds for individual veto but in days for community consultation. The T20 South Africa Taskforce's demand for "epistemic design plurality" and "bottom-up governance" (T20 South Africa Digital Transformation Taskforce, 2025) is operationalized through AHP's participatory calibration protocols, which transfer authority over temporal parameters from technical elites to affected communities. Latam-GPT's struggle for linguistic and cultural sovereignty (Brookings Institution, 2025) reveals a parallel temporal deficit: Latin America can train models on its own corpora, but it cannot yet compel those models to hesitate according to Quechua or Mapudungun deliberative rhythms. AHP addresses this deficit by asserting sovereignty not only over *what* models know, but over *when* they act.

These are not isolated demands. They form a coherent political imaginary: the refusal of compulsory velocity, the assertion of the right to one's own tempo. AHP's contribution is to demonstrate that this imaginary can be translated from declaration to design—from what nations assert to what systems enforce.

5.3 Participatory Calibration

Temporal sovereignty requires participatory governance of hesitation:

- Assemblies of Temporal Deliberation (binding power over $\Delta T_{\min}$)
- Citizen Adjustment Interfaces (no-code modification)
- Participatory Temporal Audits

5.4 Protocols as Sites of Political Struggle

Example 5.1 (Protocol as Political Statement). `HTTP/3 202 Accepted`
`PHA-Hysteresis: state=accumulating; delay=150; gamma=0.42;`

```
                veto="/api/v1/abort/tx_77"
X-Contest-URL: "https://community.forum/calibration-review"
```

This aligns with Hirsbrunner et al. (2025): contestation as practice, not feature. X-Contest-URL directs to situated, collective judgment.

5.5 Decolonial Readings

At ICEGOV 2025 (University of Witwatersrand and University of Edinburgh, 2025): "Will the Global South consume—and be consumed—or chart alternative path?" Dangote's refinery metaphor: $\Delta T_{\min}$ as domestic processing capacity. Hesitation is sovereignty.

6 Pedagogy of Hesitation

Community capacity-building to: (1) understand $\Delta T_{\min}$ trade-offs, (2) articulate temporal claims, (3) organize "temporal strikes". Prevents AHP becoming tool of experts over communities.

7 Implementation Pathways

Protocols as conceptual demonstrations—*proofs of possibility*, not solutions. Validation as political dialogue, not technical testing. Trade-offs as political choices (throughput vs. governance, delay vs. deliberation).

Alibaba-NTU (Alibaba-NTU Singapore Joint Research Institute, 2025): human-centered AI that tolerates hesitation. AHP asks: can we guarantee it architecturally?

8 Conclusion: Architecture as Critical Practice

Three moves: (1) Conceptual—latency as political substrate, (2) Analytical—vocabulary for temporal power, (3) Political—architecture as normative struggle.

AHP continues CTP (Agre, 1997; van Geenen et al., 2024): constructing alternatives that preserve space for deliberation. It reframes the question from "How can systems decide faster?" to *What political arrangements do different temporal designs materialize?*

8.1 Conceptual Limitations

- Temporal values are culturally specific (Section 3 invites, not prescribes)
- Hesitation does not guarantee justice (precondition, not accountability)
- Formalization has political consequences (we maintain reflexivity)
- Implementation uncertainties (empirical validation beyond scope)
- Paradox of peripheral position (unresolvable, constitutive)

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Declarations

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