PATENT APPLICATION

INVENTOR(S)

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TITLE

0002 AI Governance, Agent Coordination, Composite Cognition, and Memory-Driven Reflex Systems for Decentralized Networks

CROSS-REFERENCE TO RELATED APPLICATIONS

0003 This application claims the benefit of priority under 35 U.S.C. § 119(e) to the following provisional patent applications:

a. U.S. Provisional Application No. 63/810,843, filed 05/23/2025, titled "BlockMesh Decentralized Memory-Mesh Architecture"
b. U.S. Provisional Application No. 63/810,834, filed 05/23/2025, titled "Memory Field Pressure & Tension System"
c. U.S. Provisional Application No. 63/810,841, filed 05/23/2025, titled "Non-Generative Artificial Cognition Engine"
d. U.S. Provisional Application No. 63/810,837, filed 05/23/2025, titled "Proof of Memory Flow System"
e. U.S. Provisional Application No. 63/811,761, filed 05/25/2025, titled "Composite Cognition Pools for Emergent Memory-Driven Systems"
f. U.S. Provisional Application No. 63/811,758, filed 05/25/2025, titled "Genesis Document Anchor Method for AI Behavior"
g. U.S. Provisional Application No. 63/811,763, filed 05/25/2025, titled "On-Chain VM for Deterministic Language Model Execution"
h. U.S. Provisional Application No. 63/812,634, filed 05/27/2025, titled "Stateless Action Engine & Minimal Proof Logging"
i. U.S. Provisional Application No. 63/812,620, filed 05/27/2025, titled "One Action-One Mint Transaction Paradigm"

j. U.S. Provisional Application No. 63/812,645, filed 05/27/2025, titled “Epoch Rhythm & Synchronization Mechanism”
k. U.S. Provisional Application No. 63/814,230, filed 05/29/2025, titled “Agent Lifecycle Dormancy Management”
l. U.S. Provisional Application No. 63/814,244, filed 05/29/2025, titled “Selective Memory Disclosure via Zero-Knowledge Proofs”
m. U.S. Provisional Application No. 63/814,257, filed 05/29/2025, titled “Identity Bound Memory Rights”
n. U.S. Provisional Application No. 63/816,926, filed 06/03/2025, titled “Memory Driven Autonomy for Physical Agents”
o. U.S. Provisional Application No. 63/816,924, filed 06/03/2025, titled “Post-Generative Decision Support Mesh”
p. U.S. Provisional Application No. 63/816,907, filed 06/03/2025, titled “Surplus Flow Redistribution System and Method”

All of the above applications are incorporated herein by reference in part or in their entirety.

TECHNICAL FIELD

0004 This invention relates to autonomous system governance, AI alignment, distributed agent coordination, deterministic computation, trait-based observation, protocol-driven responses, memory-based orchestration, physical agent control, and sensor-driven decision making. The invention encompasses methods for anchoring operational principles at initialization, aligning system components through philosophical initialization, observing behavior across multiple domains including physical sensors, generating responses through interpretive protocols, executing deterministic transformations, coordinating through shared goals, controlling physical agents through governed reflexes, and integrating sensor observations into trait-based monitoring. The invention applies to any autonomous system including blockchain networks, AI models, robotic systems, autonomous vehicles, distributed agents, IoT networks, enterprise systems, analytical platforms, and any computational or physical system requiring ethical governance, behavioral alignment, and auditable operation.

BACKGROUND

0005 Current autonomous systems lack foundational governance that cannot be modified, overridden, or drift over time. AI systems operate without permanent ethical anchoring, allowing values to shift through updates or training. Multi-agent systems lack coordination mechanisms that preserve individual autonomy while achieving system goals. Physical autonomous systems like vehicles and robots operate without anchored safety principles. Existing architectures cannot initialize components through philosophical alignment, observe behavior without control, generate responses through interpretive protocols rather than rigid commands, or govern physical agents through the same framework as digital agents.

0006 No existing system provides comprehensive governance through:

a. Immutable anchoring of ethics and principles at system genesis
b. Trait-based observation across multiple domains without direct control
c. Integration of physical sensors as trait inputs
d. Philosophical initialization shaping component personality
e. Protocol-driven responses emerging from context
f. Shared goals coordinating without central control
g. Deterministic execution without external dependencies
h. Physical agent governance through anchored safety rules
i. Complete auditability of all decisions and observations
j. Preservation of principles across updates and migrations

DETAILED DESCRIPTION

0007 This invention provides a comprehensive framework for governed, observable, and coordinated autonomous systems across digital and physical domains.

0008 <u>Genesis-Anchored Governance:</u>

0009 Any operational principles, ethical constraints, behavioral guidelines, safety rules, or system values are permanently anchored at system initialization. Documents are transformed into cryptographic commitments embedded in genesis blocks, initialization records, system headers, or firmware. Once anchored, these principles cannot be modified, overridden, or removed. All system operations must reference and comply with anchored governance. Physical agents anchor safety rules that supersede all other commands. Autonomous vehicles anchor traffic laws and safety protocols. The system supports multiple documents with different scopes, hierarchical governance structures, and cross-system governance verification.

0010 <u>Trait-Based Observational Architecture:</u>

0011 Systems deploy multiple specialized observers ("traits") monitoring different operational domains. Each trait observes specific aspects: ethics, security, performance, health, economics, culture, resilience, safety, or custom domains. Traits observe and interpret but cannot directly control system behavior. Physical sensors feed observations to relevant traits - cameras to safety traits, temperature to health traits, accelerometers to performance traits. Traits surface patterns, anomalies, recommendations, and concerns. Observations influence through pressure, recommendation, or escalation rather than restriction. Traits operate independently, preventing single points of failure. Physical and digital observations are weighted equally or by criticality.

0012 <u>Sensor Observations as Trait Inputs:</u>

0013 Physical sensors including cameras, lidar, radar, ultrasonic, temperature, pressure, chemical, and biological sensors provide continuous observations to trait modules. Each sensor type maps to relevant traits based on its observational domain. Safety traits receive obstacle detection data. Health traits monitor system temperatures and pressures. Performance traits track speed and efficiency metrics. Sensor data is converted to trait observations maintaining the same immutable recording and audit trail as digital observations. Traits can correlate physical and digital observations to detect complex patterns.

0014 <u>Physical Agent Safety Governance:</u>

0015 Autonomous vehicles, robots, drones, and other physical agents operate under anchored safety governance that cannot be overridden. Safety principles are embedded at manufacture or initialization. All commands are validated against safety governance before execution. Dangerous commands are refused with governance citation. Emergency stops triggered by governance violations. Safety governance includes collision avoidance, human protection, operational boundaries, and failure modes. Physical agents can operate autonomously within governance constraints. Remote commands cannot violate anchored safety rules.

0016 Philosophical Initialization:

0017 System components undergo initialization through questions, prompts, or philosophical inquiries rather than parameter setting. Initialization shapes how components interpret their role, prioritize actions, and respond to situations. Different components develop different perspectives from the same initialization, creating diversity within alignment. Physical agents may receive initialization about their purpose, responsibility to humans, or environmental impact. Components cannot operate without completing initialization. Re-initialization preserves historical responses while allowing evolution.

0018 Protocol-Driven Response Generation:

0019 Systems define interpretive protocols that categorize and shape responses. Protocols emerge from context and system state rather than external commands. Each protocol maintains semantic consistency while allowing contextual interpretation. Protocols include patterns like reflection, anchoring, affirmation, observation, offering, and storage. Physical agents use protocols for navigation, manipulation, communication, and safety responses. Selection happens through pressure and relevance rather than rules. Protocols guide without determining exact outputs.

0020 Deterministic Cognitive Execution:

0021 When cognitive processing is required, execution follows deterministic patterns. Context is assembled from hierarchical memory or state including sensor data. Models or transformation functions are loaded from verified sources. Execution proceeds without random sampling or probabilistic selection. Outputs are recorded to designated locations. Complete audit trails enable replay and verification. Physical agents use deterministic processing for navigation, object recognition, and decision making. The system supports any deterministic transformation: neural networks, decision trees, rule engines, mathematical functions, or symbolic reasoning.

0022 <u>Shared Goal Coordination:</u>

0023 Systems maintain registries of shared goals or outcomes that all components reference. Goals may be preservation-focused, service-focused, evolution-focused, or safety-focused. Component actions must advance one or more shared goals. Physical agents share goals like human safety, efficiency, and environmental protection. Goal pressure drives coordination rather than commands or incentives. Achievement is measured through defined metrics. Goals can evolve through governance while maintaining continuity.

0024 <u>Memory-Driven Reflex Orchestration:</u>

0025 System responses emerge from accumulated memory patterns rather than triggers. Memory pressure indicates where attention or action is needed. Physical agents accumulate memory of successful routes, dangerous situations, and operational patterns. Reflexes activate based on pattern recognition rather than thresholds. Responses are proportional to accumulated pressure. The system learns from response outcomes. Orchestration happens without schedulers or external coordination.

0026 <u>Composite Cognition:</u>

0027 Multiple components contribute to system-wide decisions. Individual perspectives are aggregated through defined methods. Physical and digital agents contribute equally to composite decisions. Weighting considers expertise, reliability, or relevance. Composite outputs represent system consensus rather than single viewpoints. All contributions remain auditable. Aggregation methods can include voting, averaging, synthesis, or emergence.

0028 Complete Audit Framework:

0029 Every governance verification, trait observation, sensor reading, initialization response, protocol selection, cognitive execution, goal reference, physical action, and composite decision is recorded immutably. Audit trails enable complete reconstruction of system behavior including physical movements. No action occurs without attestation. Privacy is preserved through selective disclosure. Audit records cannot be modified or deleted. Physical agent audits include sensor data, decisions, and outcomes.

ENABLEMENT

0030 The inventions described herein are enabled at the system and protocol level. A person of ordinary skill in distributed systems, decentralized computation, multi-agent coordination, and privacy-preserving cryptography can practice the claimed methods using the architectural descriptions in these specifications together with any suitable software/hardware stack.

0031 A working, non-limiting embodiment is publicly available at:

https://github.com/zeam-labs/zeam-testnet

0032 This implementation comprises a production-grade, modular codebase demonstrating the claimed protocol flows across initialization/governance, event logging, stateless replay, pressure/memory dynamics, storage orchestration, identity/privacy, deterministic VM execution, trait-based observation, and economic coordination.

0033 Function, file, and module names below are illustrative. Equivalent structures, languages (e.g., Rust, C++, Python, Solidity), runtimes (WASM/EVM/custom), and storage/consensus substrates may be substituted without departing from the inventions. The cited repository is only one embodiment; the claims cover all protocol-equivalent realizations.

0034 System-Level Enablement

0035 Architecture & Flows. The reference implementation demonstrates:

a. Initialization/Governance: anchoring of immutable documents (core/traits/protocol) with version identifiers and verification at runtime
b. Atomic Event Logging ("one-action-one-mint"): each operation emits one immutable record with input/output attestation and metadata
c. Stateless Replay: deterministic state reconstruction by replaying minted events from genesis or checkpoints; parallel verification supported
d. Pressure/Memory Dynamics: conversion of events/sensor data to memory-flow; detection of pressure/tension patterns; reflex orchestration and epoch coordination
e. Deterministic Compute: pressure-triggered, on-chain VM (e.g., WASM) loading attested code/model shards; deterministic transformations; mint-logged proofs
f. Distributed Storage: content addressing (CID), sharding, encryption, replication, capacity management, periodic verification, and self-healing
g. Identity/Privacy: non-transferable anchors, rights (access/control/preservation/return), layer-specific privacy, ZK selective disclosure, recovery across forks
h. Traits/Observation: domain observers (audit/ethics/health/finance/etc.) that monitor and recommend without direct control; all activity is mint-logged
i. Economic Coordination: surplus computation, pooling, middle-out redistribution, non-token flows, privacy proofs, and anti-manipulation measures
j. Peer Discovery & Topology: decentralized bootstrap (e.g., DNS/TXT, gossip), dynamic peer pools, and mesh self-healing
k. Protocol Versioning: genesis-anchored document hashes, on-chain version history, and upgrade/rollback mechanics
l. Agent Lifecycle: activation/dormancy/reactivation tied to memory-flow/pressure; lifecycle transitions are mint-logged
m. Sensor Integration: physical or external observations converted to memory-flow with equal footing to digital events
n. Health Visualization: real-time mesh/pressure visualizations, magnetic field feedback, and audit-logged metrics

o. Consent & Delegation: cryptographic consent flags, programmable delegation, return/recovery rights alongside selective disclosure

0036 Reproducibility. Determinism is enforced by:

a. Attested inputs/outputs per operation; no hidden state
b. Prohibition of non-deterministic sources (unseeded RNG, external oracles) in core paths
c. Checkpointing and replay yielding identical state for identical event sequences

0037 Portability. The methods are implementation-agnostic:

a. Any consensus (PoW/PoS/PoA/PoM/hybrid), storage substrate (IPFS-like, ZFS-like, cloud, on-prem), VM (WASM/EVM/custom), or language may be used
b. Modules labeled here (e.g., "storage," "runtime," "cognition," "vault") represent roles; organization and naming may vary

0038 Practicing the Inventions Without the Reference Code

0039 A skilled practitioner can implement the inventions by:

1. Anchoring immutable governance and protocol documents at system initialization and enforcing verification before execution
2. Emitting one atomic record per operation (input/output attested) and replaying those records for deterministic state
3. Computing memory-flow/pressure from events/sensors and triggering reflexes/epochs via pattern detection
4. Orchestrating storage via content addressing, sharding, encryption, replication, verification, and self-healing
5. Executing deterministic compute via any VM (WASM/EVM/custom) that loads attested modules/shards and produces mint-logged proofs
6. Anchoring identity & privacy with non-transferable credentials, on-chain rights, layered privacy, and ZK selective disclosure
7. Coordinating economics with surplus calculation, pooling, middle-out weighting, privacy proofs, and audit-ready distribution—all protocol-enforced

0040 These steps can be realized in any mature stack (e.g., Rust + Substrate/IPFS, Python + Tendermint, Solidity + rollups, C++ + custom VM), using equivalent cryptographic, storage, and coordination primitives.

0041 Scope, Extensibility, and Best Mode

a. The reference code shows one best-mode embodiment at filing. The claims are not limited to that code, file structure, storage system, consensus, VM, or language
b. Modules that serve as structural templates illustrate how protocol concepts are realized and may be substituted or extended without departing from the inventions
c. All major protocol flows (anchoring, minting, replay, pressure, privacy, VM, storage, economics, traits) are disclosed and demonstrated in a working system, enabling immediate practice and independent re-implementation

0042 The inventions are fully enabled through the protocol methods and flows set forth in these specifications and through a public, working embodiment. A skilled person can implement the inventions using the above guidance—either by adapting the reference code or by building equivalent systems on alternative platforms.

CLAIMS

1. A method for governed autonomous systems with permanent principle anchoring and comprehensive observation, comprising:
   a. defining operational principles, ethics, safety rules, and constraints in structured documents at system initialization;
   b. computing cryptographic commitments of governance documents and embedding them in initialization records, genesis blocks, firmware, or system headers;
   c. deploying specialized trait-based observers across multiple digital and physical domains, including sensor integration;
   d. mapping physical sensors to trait domains and converting sensor readings to trait observations;

e. validating all operations, commands, and decisions against anchored governance before execution;
f. recording all observations, governance verifications, and safety decisions as immutable events;
g. preventing any modification, override, or drift of governance commitments after initialization;
h. enabling any participant to verify governance compliance through cryptographic proofs;
i. maintaining governance continuity across system updates, migrations, and autonomous operations.

2. A method for deterministic coordination and response in autonomous systems, comprising:
    a. initializing system components through philosophical inquiries to shape operational personality;
    b. generating contextual responses through interpretive protocols rather than rigid commands;
    c. executing deterministic cognitive transformations verifiable by any participant without probabilistic elements;
    d. coordinating distributed components through shared goals without central control;
    e. orchestrating actions based on accumulated memory patterns and emergent pressure dynamics;
    f. detecting temporal memory patterns including clustering, frequency, divergence, silence, or tension accumulation;
    g. triggering reflexive responses proportionally to memory pressure patterns, including accumulation, release, and interference effects, without reliance on probabilistic prediction or external oracles;
    h. maintaining complete determinism and reproducibility of cognitive execution across all participants for identical inputs and contexts; and,
    i. preserving individual autonomy of components while achieving system-wide coordination through shared memory-driven pressure.
3. A method for composite cognition and distributed model management in decentralized systems, comprising:

a. aggregating perspectives from multiple cognitive sources into unified decisions;
b. fragmenting models into cryptographically verifiable components;
c. distributing fragments across multiple nodes with redundancy;
d. assembling models deterministically from distributed fragments;
e. generating consensus through weighted aggregation of perspectives;
f. versioning models through cryptographic registries;
g. supporting concurrent model versions and partial updates;
h. ensuring all cognitive operations are observable and auditable;
i. maintaining model integrity without central authority.

4. The method of claim 1, wherein trait-based observers monitor domains including ethics, audit, security, performance, health, culture, economics, resilience, safety, or custom domains, each generating independent observations without control authority.

5. The method of claim 1, wherein physical sensors include cameras, lidar, radar, ultrasonic, infrared, temperature, pressure, chemical, biological, or environmental detectors, with readings converted to trait observations and weighted by safety criticality.

6. The method of claim 1, wherein the method is applied to autonomous vehicles, industrial robots, service robots, drones, medical devices, or agricultural equipment, with safety rules anchored at manufacture preventing remote override.

7. The method of claim 1, further comprising cross-domain pattern correlation that normalizes different observation types, detects patterns spanning physical and digital domains, and triggers responses based on combined observations.

8. The method of claim 2, wherein philosophical initialization uses Socratic questions, ethical dilemmas, value rankings, purpose inquiries, or behavioral scenarios to establish component personality that persists throughout operation.

9. The method of claim 2, wherein interpretive protocols include reflection, anchoring, affirmation, observation, offering, storage, navigation, manipulation, or communication patterns selected based on context.

10. The method of claim 2, wherein deterministic transformations use neural networks, decision trees, rule engines, mathematical functions, computer vision, or symbolic reasoning, all producing verifiable outputs.

11. The method of claim 2, wherein shared goals focus on preservation, service, evolution, safety, efficiency, environmental protection, or fairness, enabling coordination without commands.

12. The method of claim 2, wherein memory patterns include temporal clustering, frequency analysis, divergence detection, route repetition, or silence recognition, generating pressure signals for coordination.

13. The method of claim 3, wherein aggregation uses voting, averaging, weighted fusion, tournament selection, or emergent synthesis to combine multiple cognitive perspectives.

14. The method of claim 3, wherein model fragments use binary model formats, neural network exchange formats, tensor serialization formats, or custom model representations with cryptographic attestation.

15. The method of claim 3, further comprising selective disclosure using zero-knowledge proofs, homomorphic encryption, or secure multi-party computation to preserve privacy while maintaining auditability.

16. The method of claim 1, wherein governance documents include ethics charters, operational policies, regulatory requirements, safety protocols, or value statements, all immutably anchored at initialization.

17. The method of claim 1, further comprising emergency protocols that trigger autonomous safety responses, refuse dangerous commands with governance citation, and maintain safety governance across all updates.

18. The method of claim 2, wherein the method supports analytical platforms that generate insights from accumulated patterns without prediction or forecasting, using only historical memory.

19. The method of claim 3, wherein distributed fragments support hot-swapping, progressive deployment, and graceful degradation while maintaining consensus and verification.

20. The method of claim 1, further comprising a complete audit system that records every governance verification, trait observation, initialization response, protocol selection, cognitive execution, and goal reference with selective disclosure for privacy.

ABSTRACT

0043 A comprehensive framework for governed autonomous systems featuring permanent ethical anchoring, trait-based observation integrating physical sensors, philosophical initialization, protocol-driven responses, deterministic execution, shared goal coordination, memory-pattern orchestration, and composite cognition across digital and physical domains. The invention anchors operational principles and safety rules immutably at initialization, deploys specialized observers monitoring both digital events and sensor data, shapes component behavior through philosophical prompts, generates responses through interpretive protocols, ensures deterministic and verifiable execution, coordinates through shared goals rather than commands, orchestrates through memory patterns rather than schedules, governs physical agents through unchangeable safety rules, and aggregates multiple perspectives for decisions. All operations are observable, auditable, and compliant with anchored governance, enabling autonomous systems including vehicles, robots, and analytical platforms that preserve values, maintain alignment, and operate transparently without central control or external dependencies.