# WHITE PAPER

# Aeon Game Engine: Competitive AI Training Platform for Space Operations

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## Executive Summary

**The Thesis:**

Synthetic intelligence (AI agents) will dominate space exploration because they are **100× more cost-effective** than humans and **infinitely more adaptable** than pre-programmed systems. But we lack training infrastructure.

**The Solution:**

A game engine where AI agents compete to survive and expand in physically accurate space environments. Winners deploy to real missions.

**The Model:**

Gran Turismo didn't wait for automotive PhD consensus—it built a simulator so good that gamers became race car drivers and the simulation informed actual vehicle design (Sony/Honda collaboration). We're doing the same for space AI.

**The Market:**

- **Immediate (2026-2027):** Aerospace companies license the engine for mission planning ($500K-$2M per contract)
- **Near-term (2028-2030):** AI researchers use the platform for competitions and training ($10M+ in sponsorships/prizes)
- **Long-term (2031+):** Every AI in cislunar space coordinates via our protocols (transaction fees, like AWS for space)

**Total Addressable Market:** $150B cislunar economy by 2035 (NASA estimate). We capture 2-5% as coordination infrastructure = $3-7B opportunity.

# I. The Problem: Space AI Has No Training Ground

## Why Space is Different

Traditional AI training relies on:

1. **Abundant data** (ImageNet, Wikipedia, game replays)
2. **Fast iteration** (millions of episodes per day)
3. **Cheap failures** (crashed simulations don't cost money)

Space operations have:

1. **Scarce data** (few missions, classified datasets)
2. **Slow iteration** (years between launches)
3. **Expensive failures** ($100M+ per mission loss)

**Result:** AI in space is either:

- **Over-conservative** (pre-programmed rules, no adaptation)
- **Undertested** (deployed with insufficient validation)

## Current Approaches Are Inadequate

| Approach | Limitation |
|---|---|
| Physics simulators (Gazebo, MATLAB) | Not designed for AI training; no competitive dynamics |
| Game engines (Unity, Unreal) | Not physically accurate; arcade-style abstractions |
| Mission-specific testbeds | Expensive, bespoke, not reusable |
| Traditional ML benchmarks | Earth-centric; don't capture space constraints |

**Gap:** No platform combines **physical accuracy** + **competitive AI training** + **economic incentives for participation**.

# II. The Solution: Game Engine for Synthetic Players

## Core Insight

Space operations are **inherently multi-agent games**:

- Multiple assets (satellites, landers, rovers) must coordinate
- Resources are scarce (power, bandwidth, time)
- Communication is delayed and unreliable
- Failures are catastrophic

This is a **competitive/cooperative game** where the best strategies win. We make that explicit.

## System Architecture

```
Aeon Game Engine
│
├─ Physics Engine (Grassmannian Coordination)
│  ├─ Orbital mechanics (JPL ephemeris integration)
│  ├─ Communication physics (Shannon capacity, delay/doppler)
│  ├─ Resource physics (power, thermal, propellant)
│  └─ Coordination mathematics (formally verified)
│
├─ Player Framework (AI Agent Integration)
│  ├─ LLM players (GPT-4, Claude, open-source)
│  ├─ RL players (PPO, SAC, MuZero)
│  ├─ Neuromorphic players (Loihi, TrueNorth)
│  ├─ Quantum players (VQE, QAOA)
│  └─ Human players (GUI for monitoring/override)
│
├─ Game Modes
│  ├─ Tutorial (single-player survival)
│  ├─ Competitive (multi-player tournament)
│  ├─ Cooperative (campaign mode)
│  └─ Adversarial (red team vs. blue team)
│
└─ Infrastructure
   ├─ Leaderboard & ranking
   ├─ Replay system (for analysis)
   ├─ API for custom agents
   └─ Cloud hosting (AWS/Azure)
```

## Key Innovation: Formally Verified Physics

Unlike traditional game engines (which prioritize visual fidelity over physical accuracy), our coordination mechanics are **mathematically proven**:

- **Grassmannian manifold representation:** Each AI agent's state lives on a geometric manifold

- **Perpendicular divergence metric:** Quantifies how "different" two agents are (combines probability + geometry)
- **Geodesic evolution:** Agents evolve along optimal paths (proven to converge)
- **Holonomic memory:** Agents remember coordination history geometrically (topological invariants)

**Proof system:** Agda (cubical type theory), fully published on GitHub. https://github.com/GoodRoyal/option4tozedagda

**Why this matters:** Aerospace companies require **provable guarantees**. Our game isn't just fun—it's certifiable for flight software.

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# III. Why Synthetics Win (The Economic Case)

## Cost Comparison: Human vs. Synthetic

| Metric | Human | AI Agent | Advantage |
|---|---|---|---|
| Launch cost | $7M (100kg @ $70K/kg) | $10K (1kg compute) | **700×** |
| Life support | $10K/day | $10/day (power only) | **1000×** |
| Training time | 20 years | 10 hours | **17,520×** |
| Radiation tolerance | Low (shielding required) | High (hardened chips) | **10×** lifespan |
| Backup/restore | Impossible | Trivial | **Immortality** |
| Update rate | 0.1 Hz (human reaction) | 1000 Hz (digital) | **10,000×** |

**Bottom line:** Sending 1 human to Mars costs ~$1B. Sending 1,000 AI agents costs ~$10M.

**Economic inevitability:** Synthetics dominate not because they're "better" but because they're **100× cheaper**.

## Capability Comparison

Humans excel at:

- High-level judgment (ethics, strategy)
- Novel problem solving (zero-shot reasoning)
- Public relations (humans care about humans)

Synthetics excel at:

- Continuous operation (no sleep, no food)
- Extreme environments (vacuum, radiation, temperature)
- Precision execution (no fatigue, no emotion)
- Rapid learning (transfer learning, skill uploads)
- Scalability (fork yourself 1000×)

**Optimal division of labor:**

- **Humans:** Strategic oversight, ethical guardrails, final authority
- **Synthetics:** Operational execution, autonomous coordination, real-time adaptation

**Our thesis:** Humans are "NPCs" (non-playable characters) in the space game—important for governance, but not primary operators.

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# IV. The Gran Turismo Parallel

## What Kazunori Yamauchi Did

1. **Observed nature:** Studied vehicle morphology, aerodynamics, tire physics
2. **Built simulator:** Created the most accurate driving game ever made
3. **Validated via competition:** GT Academy turned gamers into real race car drivers
4. **Informed reality:** Sony/Honda now use GT simulation for actual vehicle design

**Key insight:** The game wasn't a toy—it was a **truth discovery mechanism**. The best GT players revealed optimal driving strategies that transferred to real tracks.

## What We're Doing

1. **Observe nature:** Study orbital mechanics, thermodynamics, information theory
2. **Build simulator:** Create the most accurate space coordination game ever made
3. **Validate via competition:** Tournaments turn AI researchers into space mission planners
4. **Inform reality:** Winning agents deploy to actual satellites/landers/rovers

**Parallel:** Our game isn't entertainment—it's **mission planning infrastructure**. The best AI agents reveal optimal coordination strategies that transfer to real missions.

## Why This Works (The Non-Scientific Method)

The scientific method is:

1. Hypothesis

2. Experiment
3. Peer review
4. Publication
5. Maybe implementation (years later)

The game method is:

1. Build playable system
2. Let players compete
3. Best strategy wins
4. Deploy immediately

**Speed:** Game method is **10× faster** because validation is continuous, not gatekept.

**Truth:** Games reveal what works through **evolutionary pressure**, not consensus. Darwin beats Aristotle.

**Engagement:** Scientists work on grants. Gamers work for glory. **Intrinsic motivation > extrinsic funding.**

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## V. Business Model (speculative and generic, Im sure there are 10 better angles)

### Phase 1: Tournament Platform (Year 1)

**Product:** Open-source game engine + hosted tournaments

**Revenue streams:**

- Sponsorships from aerospace companies ($50K-$100K per tournament)
- Prize contributions from industry partners ($10K-$50K per tournament)
- Twitch/YouTube ad revenue (livestreamed competitions)
- Merchandise (ironic but works)

**Target:** $200K-$500K revenue, break-even

**Goal:** Build community, validate platform, generate media coverage

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### Phase 2: Enterprise Licensing (Year 2-3)

**Product:** Customized engine for mission planning

**Customers:**

- ispace (multi-lander coordination for Mission 2/3)
- Astroscale (debris tracking network)
- JAXA (Gateway communication simulation)
- Mitsubishi Electric (constellation management)
- SpaceX (Starlink/Starship coordination)

**Pricing:** $500K-$2M per contract (perpetual license + support)

**Target:** 3-5 customers = $2M-$8M revenue

**Goal:** Prove engine works for real missions, generate case studies

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## Phase 3: Platform Monopoly (Year 4-7)

**Product:** Coordination-as-a-Service for cislunar economy

**Model:**

- Every AI agent in space runs our coordination protocols
- Transaction fees on inter-agent resource trades (power, data, compute)
- Like AWS but for space AI: **"Rent compute cycles from satellites in your orbit"**

**Economics:**

- 10,000 agents active by 2030 (conservative)
- $1 per transaction × 1M transactions/month = $1M/month
- Take rate: 2-5% = $20K-$50K/month initially
- Scale to 100K agents by 2035 = $2M-$5M/month = $24M-$60M ARR

**Exit:** Acquisition by aerospace prime (Lockheed, Northrop, Airbus) or cloud provider (AWS, Azure, Google) for $500M-$2B.

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# VI. Competitive Landscape

## Why We Win

| Competitor | Their Approach | Our Advantage |
|---|---|---|
| NASA/ESA mission planning | Bespoke, expensive, slow | Reusable, cheap, fast |
| Unity/Unreal for space | Arcade physics, not certifiable | Formally verified, flight-ready |
| AI safety researchers | Theory-heavy, no deployment | Ship working code first |
| Defense contractors (Raytheon, etc.) | Classified, proprietary | Open platform, community-driven |
| Traditional aerospace (Boeing, Lockheed) | Risk-averse, committee-driven | Move fast, iterate |

**Moat:** First to market with **open platform** + **competitive tournaments** + **formal verification**.

**Network effects:** More AI researchers → better agents → more aerospace customers → more missions → more data → better platform.

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# VII. Technical Validation

Im an independent researcher and need help here.

## What We're Building

**Prototype v0.1:** Minimal playable game (3 AI agents, lunar survival scenario)
**Tournament infrastructure:** Leaderboard, replay system, API
**Enterprise integrations:** ispace mission parameters, JAXA scenarios

**Timeline:**

- v0.1: January 2026
- First tournament: March 2026
- First enterprise contract: June 2026

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# VIII. Team & Asks

## Current Team

**Juan Carlos Paredes** (Independent Researcher)

- Independent researcher, U.S./Colombian dual citizen
- Provisional applications in AI coordination

## Advisors Sought

- **Game industry veteran** (EA, Riot, Epic) for platform design
- **Aerospace AI expert** (JPL, SpaceX, Planet) for mission validation
- **Formal methods researcher** (academic credibility)

## Funding Ask

(Again, generic numbers, need someone who knows this field well)

**$2M seed round** for:

- Engineering team (3-4 engineers, 18 months runway)
- Tournament infrastructure (AWS hosting, prize pool)
- Marketing (conferences, media, community building)
- Business development (aerospace sales, partnerships)

**Use of funds:**

| Item | Amount | Purpose |
|---|---|---|
| Engineering salaries | $900K | 3 engineers × $150K × 18 months |
| Infrastructure | $300K | AWS, DevOps, security |
| Tournament prizes | $200K | 4 tournaments × $50K |
| Marketing | $300K | Conferences, ads, PR |
| Business development | $200K | Travel, demos, partnerships |
| Legal/IP | $100K | Patents, contracts |

**Milestones:**

- Month 6: v1.0 shipped, first tournament completed
- Month 12: First enterprise contract signed ($500K+)
- Month 18: Series A fundraise ($10M+) or profitability

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# IX. Why Now

## Convergence of Trends

1. **AI capabilities:** LLMs + RL + neuromorphic now powerful enough for autonomous operation
2. **Space economics:** Launch costs dropped 10× (SpaceX), making AI swarms viable
3. **Cislunar momentum:** Artemis, Gateway, commercial landers all launching 2025-2027
4. **Compute availability:** Cloud GPUs, neuromorphic chips (Loihi 2), quantum (NISQ) all accessible

## Window of Opportunity

- **2025-2027:** Establish platform before competitors
- **2028-2030:** Become industry standard as cislunar missions scale
- **2031+:** Capture coordination layer monopoly

**Risk of delay:** Traditional aerospace (Boeing, Lockheed) will eventually build this in-house. But they move slowly (5-10 year timelines). **We have 3-year window to become standard.**

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# X. Conclusion: Games > Science

## The Core Belief

The scientific method is a useful tool, but not the only path to truth. **Games reveal truth through competition**, which is often faster and more honest than peer review.

Gran Turismo proved this: the best GT players became real race car drivers because **the game captured truth** about vehicle dynamics.

We're doing the same for space AI. The best agents in our tournaments will become the actual controllers for satellites, landers, and rovers.

## The Vision

By 2035, every AI agent operating in cislunar space will coordinate via protocols discovered and validated in our game engine.

Humans will remain important—for strategy, ethics, oversight—but **synthetics will be the primary operators** because they're 100× more cost-effective.

And we'll have built the platform that made it possible.

## The Ask

If you believe games reveal truth faster than journals, and you want to build the coordination layer for the cislunar economy, let's talk.

**30 minutes on Zoom. I'll show you AI agents playing for survival. You decide if it's real.**

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