Hollow Orbit: Survival Mechanics

Mathematical Core Documentation

Orbital Decay and System Mechanics

The core survival gameplay of **Hollow Orbit** is driven by a set of simplified, deterministic equations that model the gradual, inevitable decay of the orbital habitats.

The Core Decay Metric: Orbital Integrity (I)

The habitat's stability is tracked by the Orbital Integrity (I). If $I \leq 0$, the orbit fails. The change in Integrity over time ($\frac{dI}{dt}$) is the sum of various decay rates:

$$\frac{dI}{dt} = -(R_{\text{Base}} + R_{\text{Drag}} + R_{\text{Instability}})$$

- I: **Orbital Integrity** (0–100). The primary survival metric.
- R_{Base}: **Inherent Decay Rate** (constant set per orbit).
- R_{Drag}: **Atmospheric Drag Rate** (variable, influenced by hull health).
- $R_{\text{Instability}}$: **System Instability Rate** (variable, influenced by broken components).

Variable Decay Rates (Player Agency)

Atmospheric Drag (R_{Drag})

Drag increases non-linearly as the **Hull System Integrity (H_{System})** drops below a threshold (e.g., 50), simulating a descent into denser atmosphere.

$$\text{If } H_{\text{System}} \leq 50: \quad R_{\text{Drag}} = \alpha \cdot \left(1 - \frac{H_{\text{System}}}{100}\right)^2$$

- H_{System}: Hull System Integrity (0–100).
- α: Drag Constant (A difficulty scaling factor).

System Instability ($R_{\text{Instability}}$)

Instability is a direct penalty based on the failure of critical internal systems, represented by the sum of penalties from failed components.

$$R_{\text{Instability}} = \sum_{n=1}^{N} W_n \cdot B_n$$

- N: Total number of critical components.
- W_n: Component Weight/Criticality (fixed value for component n).
- B_n: Broken State Multiplier (binary: $B_n = 1$ if Component Integrity ≤ 0; $B_n = 0$ otherwise).

Player Actions and Resource Consumption

Repair Action (Increasing Component Integrity)

The repair action increases a specific component's integrity (ΔH_{System}) by consuming both Power (P) and Resources (R_{es}).

$$\Delta H_{\text{System}} = \frac{\beta \cdot P_{\text{Consumed}} \cdot R_{\text{es}_{\text{Consumed}}}}{\text{Max } H_{\text{System}}}$$

- β: Repair Efficiency constant.
- P_{Consumed}, $R_{\text{es}_{\text{Consumed}}}$: Consumed amounts of Power and Resources per tick.

Orbit Transfer Difficulty Progression

The difficulty increases with each new habitat, reinforcing the narrative of inevitable decay. The new orbit's inherent decay rate ($\hat{R}_{\text{Base}}$) is guaranteed to be worse.

$$\hat{R}_{\text{Base}} = R_{\text{Base}_{\text{Previous}}} + \gamma$$

- γ: Decay Escalation Constant (A fixed positive value for difficulty increase).