GAME 3 DEVELOPMENT HANDOFF: THE ANATOMY OF TIG PRECISION

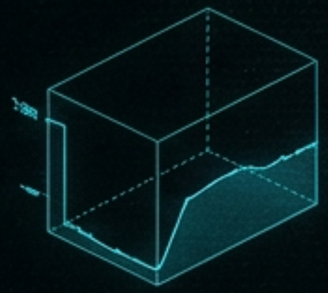
SESSION ID:	SEASON 2	OPERATOR	AWS D1.1	GTAW



ARC LENGTH: 0.8MM

VOLTAGE: 14.2V

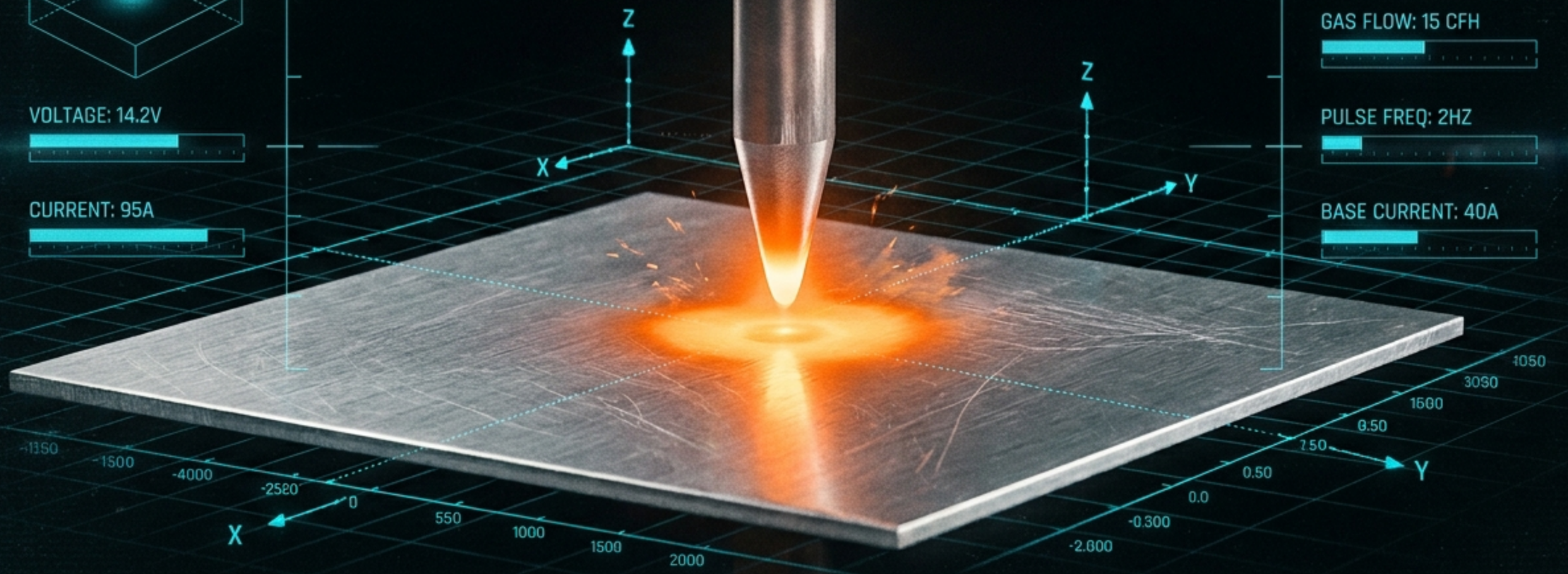
CURRENT: 95A



GAS FLOW: 15 CFH

PULSE FREQ: 2HZ

BASE CURRENT: 40A



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THE “FOCUS SECRET” SEPARATES AMATEURS FROM OPERATORS

LEFT_INPUT: CLUTCH MODULATION

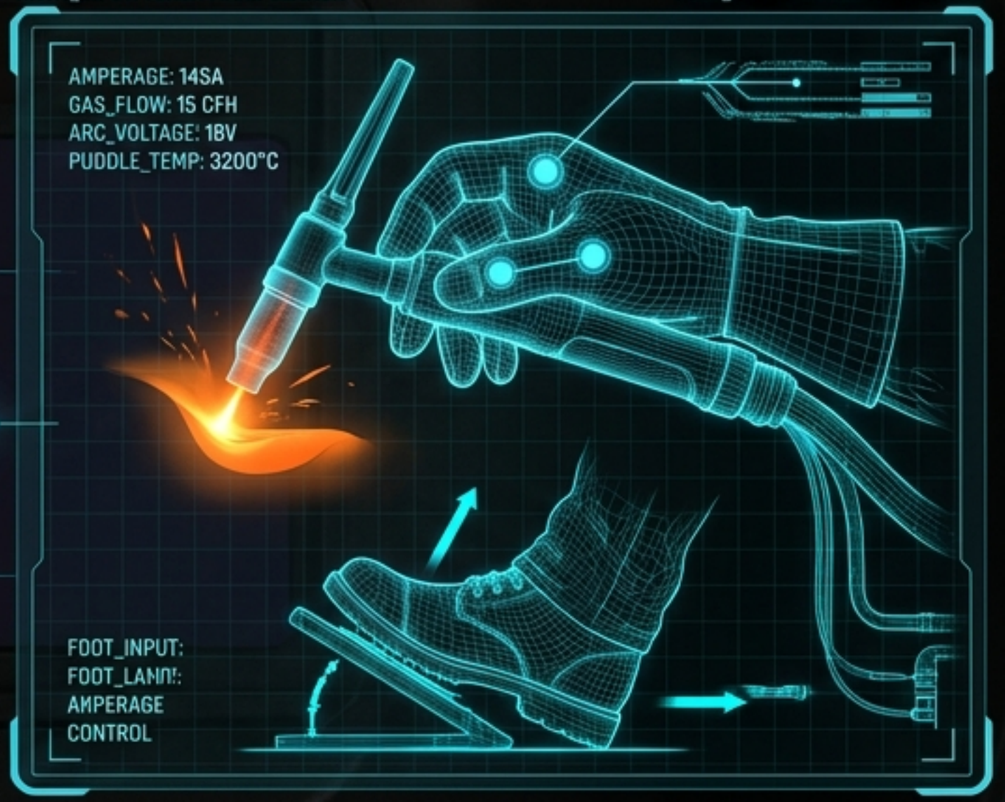
RIGHT_INPUT: STEERING VECTOR



DUAL-LIMB ASYMMETRY

RIGHT_INPUT: TORCH MANIPULATION

FOOT_INPUT: AMPERAGE CONTROL



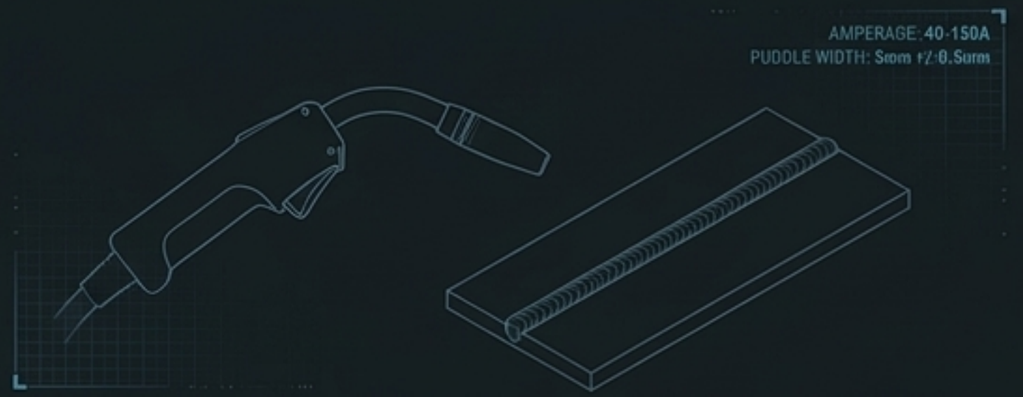
MASTER INSTRUCTORS IDENTIFY GAS TUNGSTEN ARC WELDING (GTAW) AS THE ULTIMATE TEST OF COGNITIVE LOAD. PLAYERS MUST DECOUPLE THEIR HAND'S SPATIAL POSITIONING FROM THEIR FOOT'S PRESSURE OUTPUT, MANAGING SIMULTANEOUS, ASYMMETRIC INPUTS TO SUSTAIN A VOLATILE PHYSICAL STATE.

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Process Input Evolution: Point & Shoot vs. Dual-Limb Asymmetry

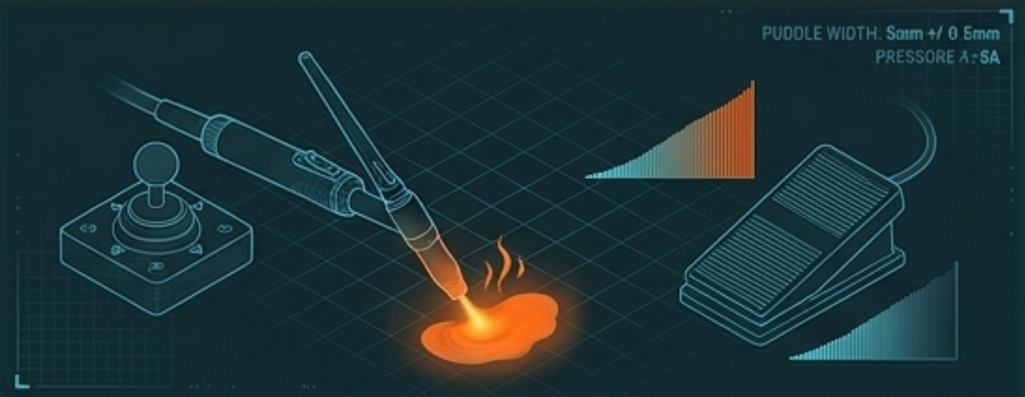
Games 0-2 (MIG GMAW)

Input: Single binary trigger (On/Off)
Cognitive Load: Low to moderate
Primary Game Focus: Spatial travel speed, basic puddle tracking
Material: Thick steel (forgiving thermal state)



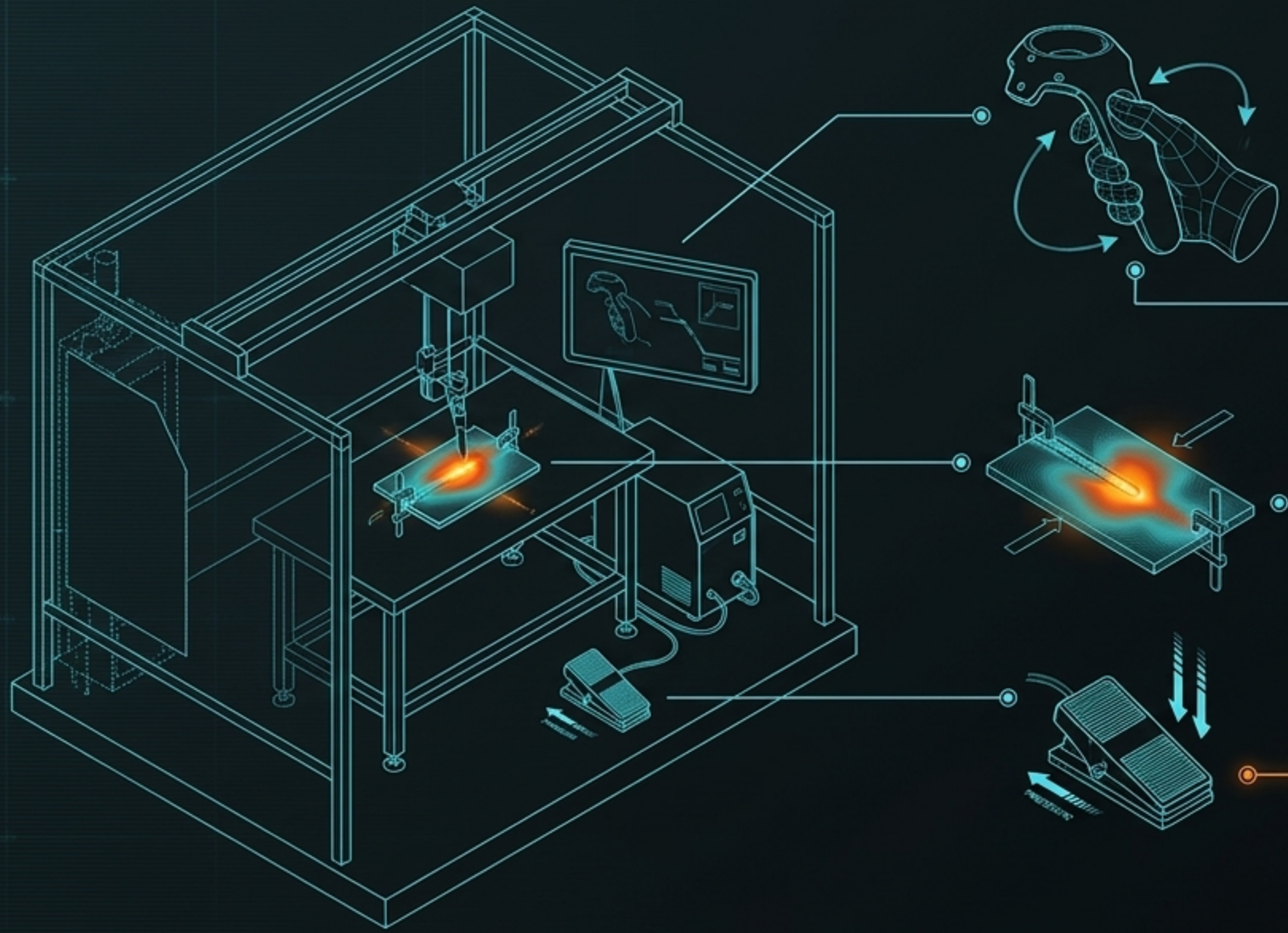
Game 3 (TIG GTAW)

Input: Analog spatial joystick + Analog foot pedal (Scalar)
Cognitive Load: High (Simultaneous dual-tasking)
Primary Game Focus: Dynamic amperage stability, micro-arc length adjustments
Material: Thin aluminum (highly volatile thermal saturation)



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GAME 3 ENVIRONMENTAL ARCHITECTURE



OBJECTIVE PARAMETER:

Weld thin aluminum joint using GTAW process without causing thermal collapse.

CONTROL LAYER A:

Right-hand joystick dictating spatial X/Y/Z torch positioning.

CONTROL LAYER B:

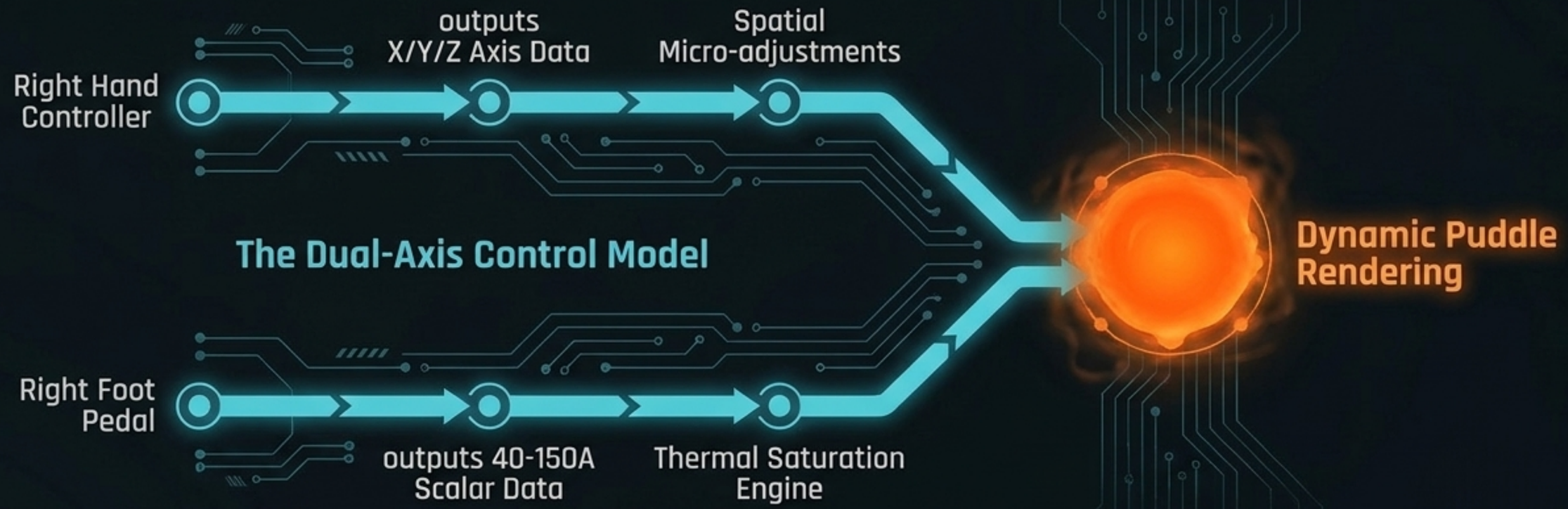
Foot pedal generating dynamic amperage scalar data.

CRITICAL FAILURE STATES:

- Burn-Through: Excessive pedal pressure relative to material heat saturation.
- Loss of Arc: Insufficient pedal pressure to sustain the plasma column.
- Erratic Puddle: Inconsistent hand travel speed.

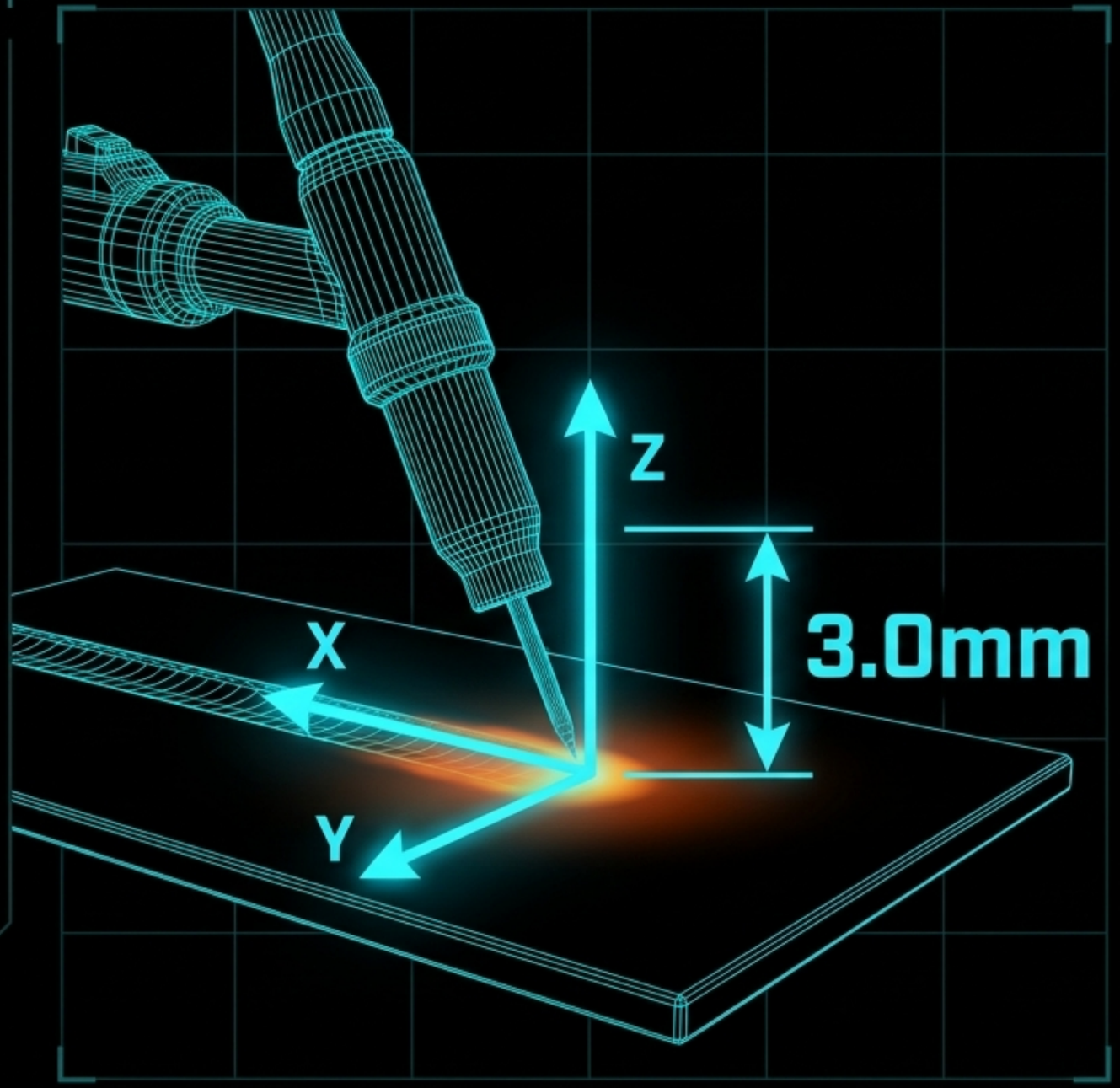
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Two Independent Inputs Converge on a Singular Physics Output



The simulation engine must continuously calculate the interiraction between physical hand location and analog foot pressure to dynamically update the thermal mass and visual rendering of the molten aluminum puddle at 60 frames per second.

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Spatial Telemetry: The Right Hand

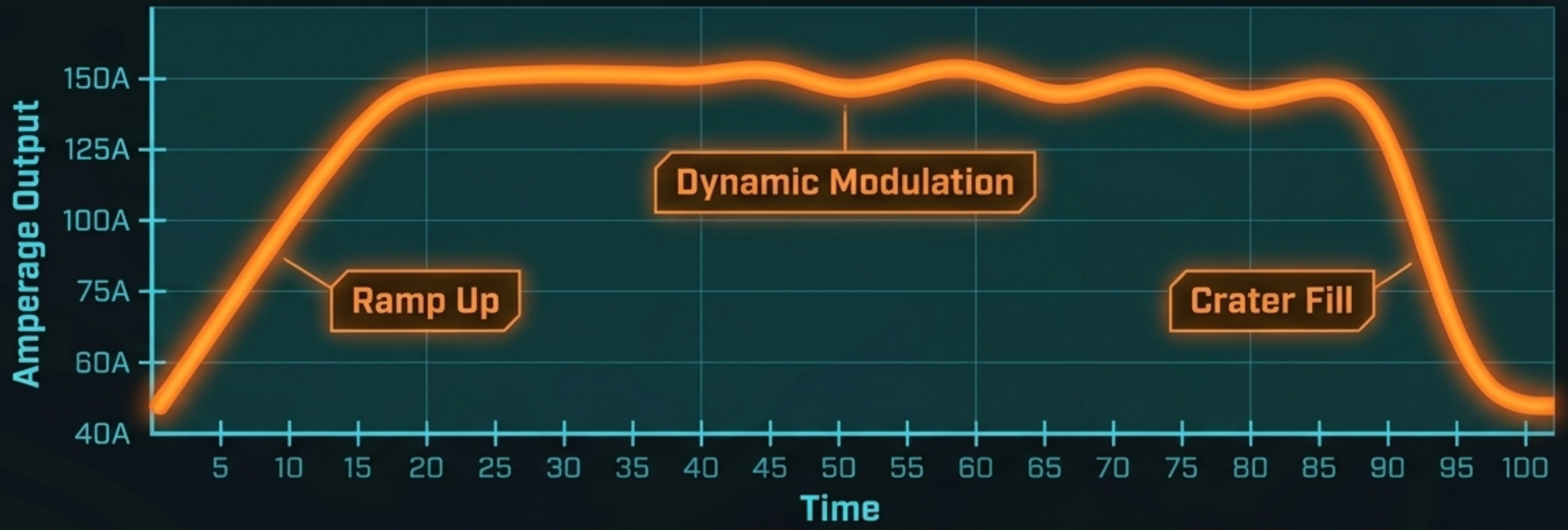
1	**Strict Travel Speed:**
	5mm/s (+/- 0.5mm/s tolerance).

2	**Strict Arc Length Distance:**	
	3mm	absolute requirement.

System Response: The simulation applies **heavy penalty weights** to the **Z-axis**. Joystick inputs control micro-adjustments; any deviation outside the 3mm +/- threshold instantly triggers a **haptic warning sequence**.

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Thermal Scalar: Amperage Modulation via the Foot Pedal



Target Operating Range

40A to 150A.

The Heat Saturation Variable

Thin aluminum retains **heat**. The player cannot simply hold the pedal at 100%. As the plate absorbs heat over time, the player must imperceptibly **reduce pedal pressure** to maintain the **exact same puddle diameter**, fighting the game's thermal buildup algorithm.

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The Core Dependent Variable: Puddle Dynamics

Target State:

Maintain a molten puddle diameter of exactly **5mm (+/- 0.5mm)** while in continuous motion.



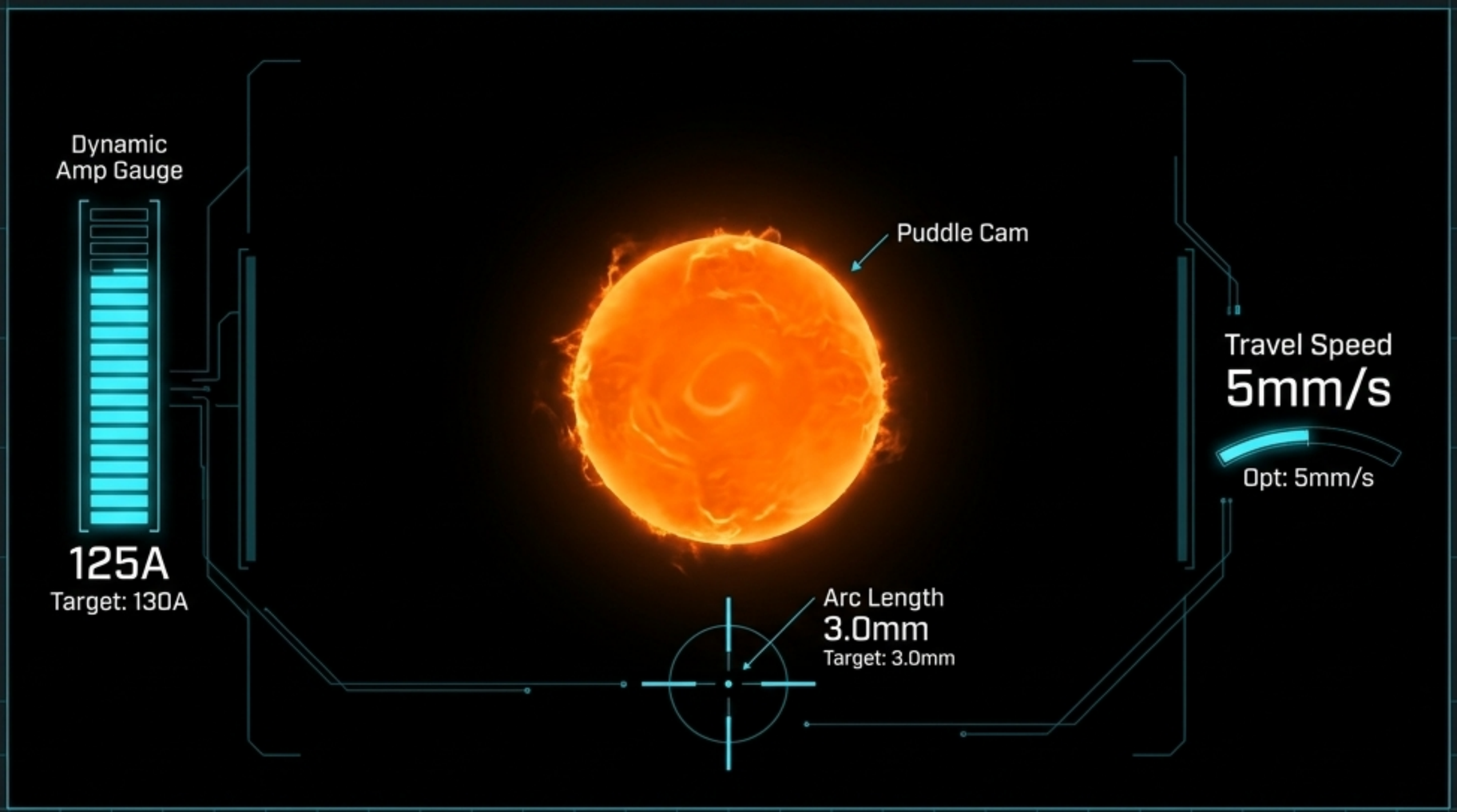
Rendering Priority:

Visual feedback to the player relies entirely on puddle behavior. Engine resources must prioritize the fluid dynamics, width expansion, and color intensity of this 5mm target area above all other environmental rendering.

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The “Shade 13” Heads-Up Display Architecture

Peripheral telemetry only. The UI must simulate the restricted field of view inside an auto-darkening welding helmet. All cognitive focus remains locked on the center puddle cam.

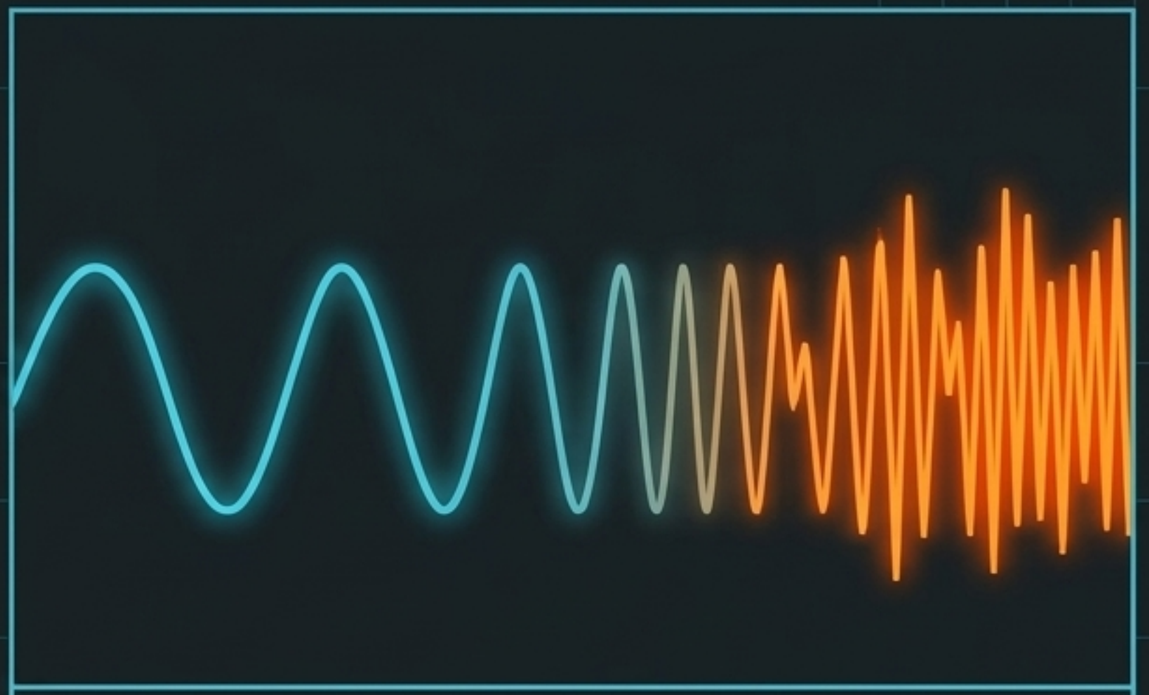


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Replacing Thermal Sensation With Haptics and Audio



Spatial Error Feedback: Haptic rumble motors isolate Z-axis deviations. Vibrations intensify exponentially as arc length drops below 2.5mm 2.5mm or exceeds 3.5mm.



Electrical State Feedback: Audio engineering must tie pedal pressure directly to an AC TIG arc sound profile. The electrical “buzz” must pitch-shift dynamically in real-time between the 40A and 150A thresholds, allowing players to tune amperage entirely by ear.

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DEFECT ENGINE: TRANSLATING MECHANICS TO AWS TABLE 4.11

- **BURN-THROUGH:** TRIGGERED BY PEDAL SPIKING / EXCESSIVE HEAT INPUT ON THIN GAUGE ALUMINUM.
- **UNDERCUT:** TRIGGERED BY A TOXIC RATIO OF HIGH AMPS (PEDAL) COMBINED WITH EXCESSIVE TRAVEL SPEED (JOYSTICK).
- **POROSITY:** TRIGGERED BY LOSS OF GAS COVERAGE, SPECIFICALLY WHEN Z-AXIS ARC LENGTH EXCEEDS CRITICAL LIMITS, INTRODUCING OXYGEN TO THE PUDDLE.

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Bridging Simulation and Real-World Qualification





OSHA Compliant Environment

29 CFR 1910.252 requirements mandate virtual PPE checks, auto-dark variable shade operation, and ventilation activation before the simulation permits arc strikes.

AWS D1.1 Preparation

Mastering Game 3 is the mandatory gateway. The visual consistency demanded by the 5mm puddle engine directly trains the player's eye for the 100% visual pass rate required in destructive bend tests later in the curriculum.

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The Simulation Scoring Engine: Macro Weights



40% Accuracy Engine

30% Consistency Algorithm

30% Safety Protocol

In Game 3, the generic "Accuracy" metric is heavily overridden to track Amperage Stability (pedal) and Puddle Diameter Control. "Consistency" targets the 5mm/s travel speed. "Safety" mandates perfect procedural execution before arc initialization.

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XP Calculation API: The D1.1 Penalty Formula

```
calculateXP(accuracy, consistency, defects) {
  const base_acc = Accuracy * 10;
  const base_con = Consistency * 5;
  const penalty = Defects * 50;

  return (base_acc + base_con) - penalty;
}
```

Severe Defect Penalties: A single instance of Porosity or Undercut triggers the 50x multiplier penalty, mathematically preventing progression to the next tier without a flawless run.

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Sprint Actions: Unlocking the Operator Tier

Synthesis: Passing Game 3 proves mastery of the "focus secret," moving players to the Days 31-60 Operator Tier (2000XP, 85% proficiency), unlocking 2G/3G positions and blueprint reading.

Game 3 Pass



Operator Tier Unlocked

Developer Action Items / API Webhooks:

- [x] - Connect dual-axis inputs to Unity MVP puddle renderer.
- [x] - Log telemetry via `game.completed` and `tier.achieved`.
- [x] - Required Payload Fields: `gamertag`, `tier`, `xp`, `safety_score`, `best_position`, `aws_qual`.

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