Virtual Reality + Leap Motion for Enhanced Air Traffic Control (ATC)

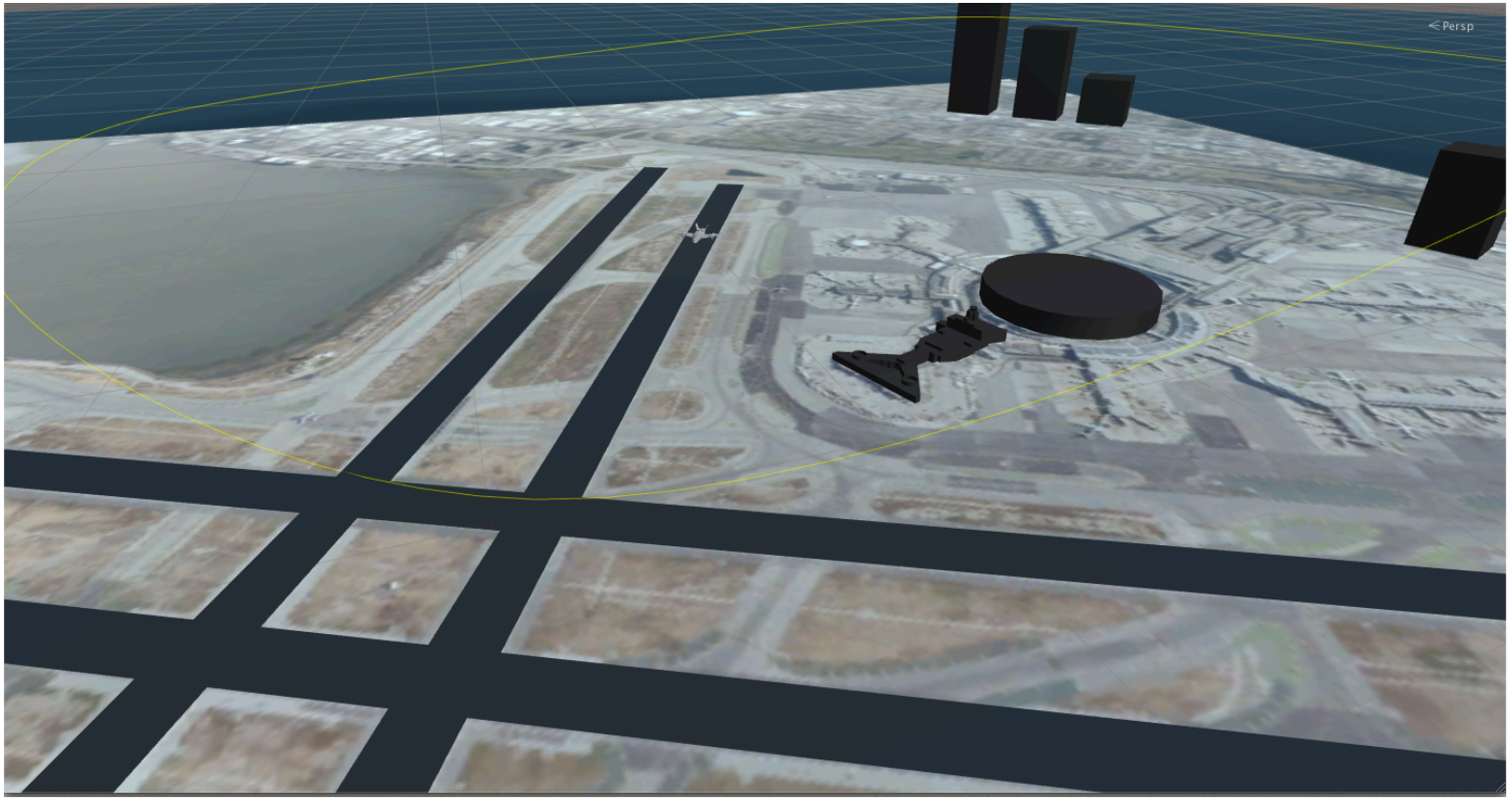
Andrew Moran

6.835: Final Presentation

12 May 2015

Introduction

- **Create an Immersive and Interactive Simulation for ATC controllers to coordinate planes**



Sample Walkthrough (Just a Taste ☺)

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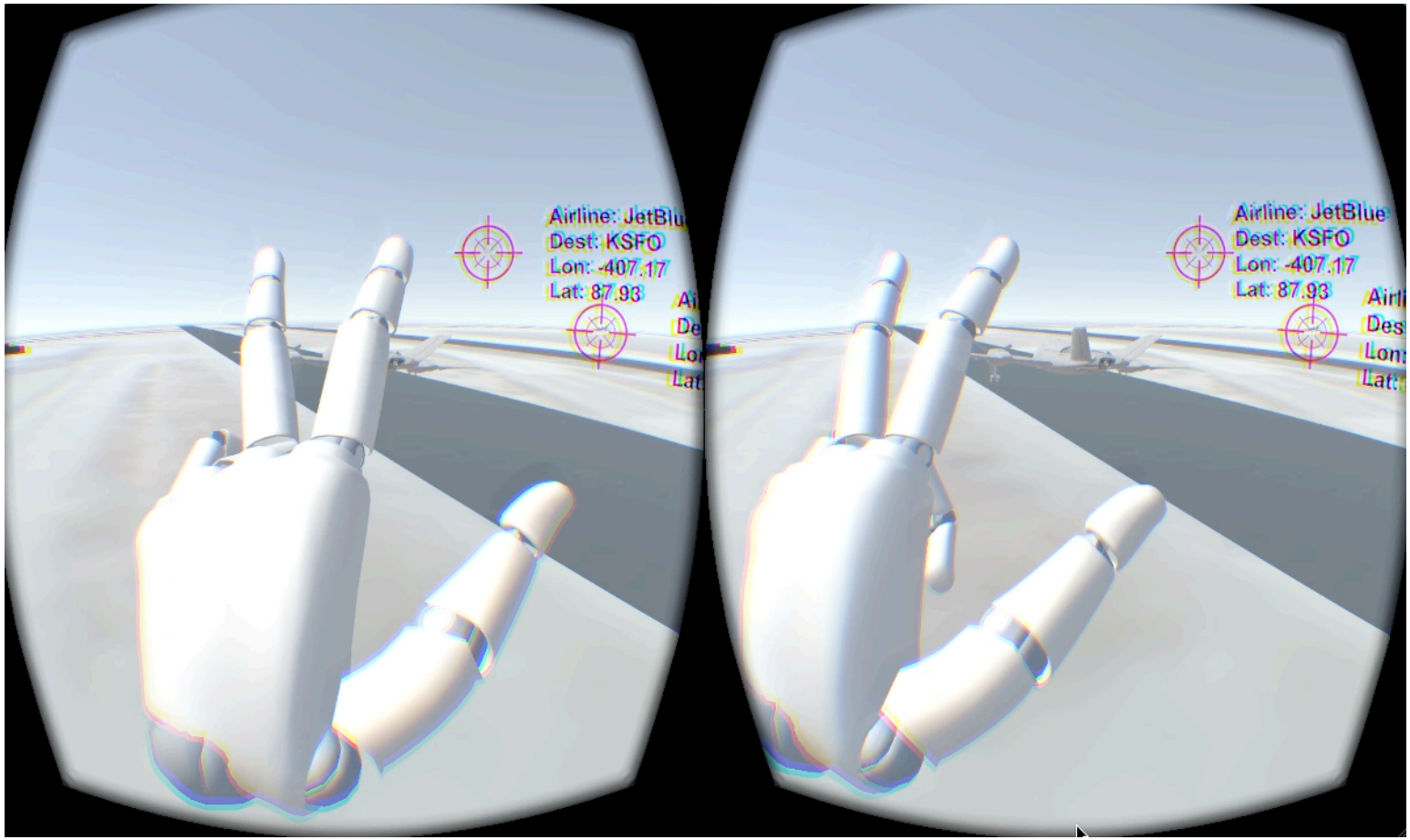

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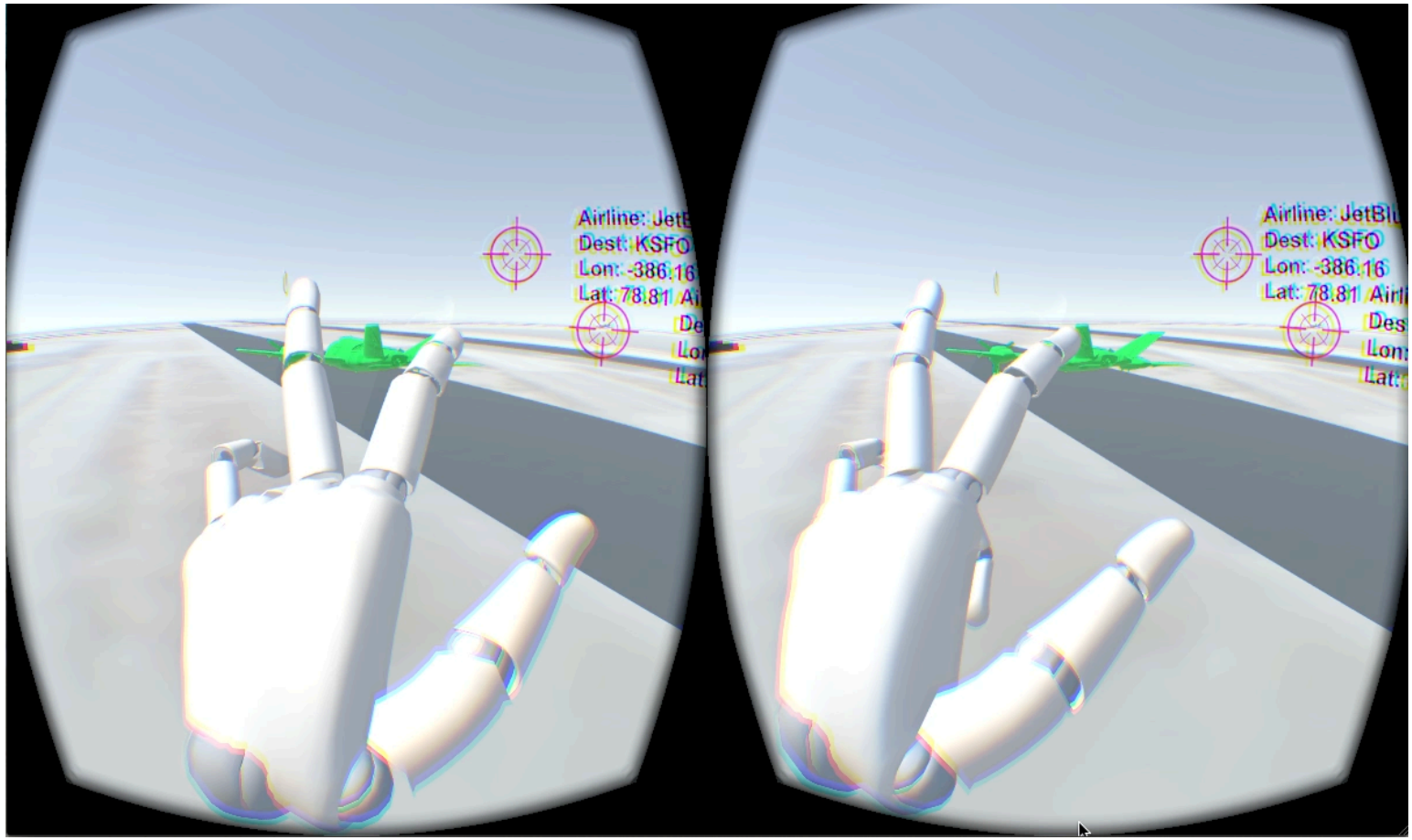

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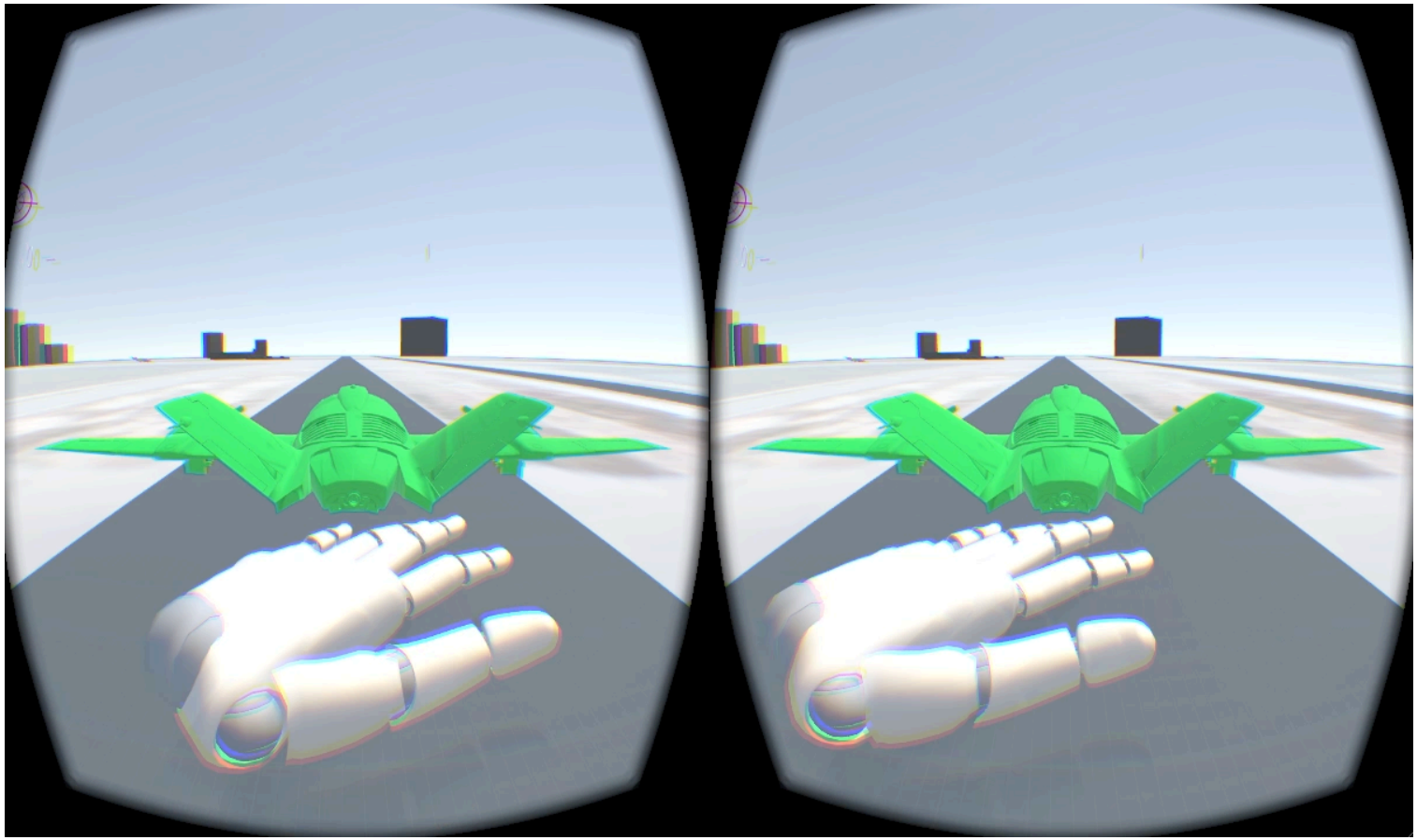

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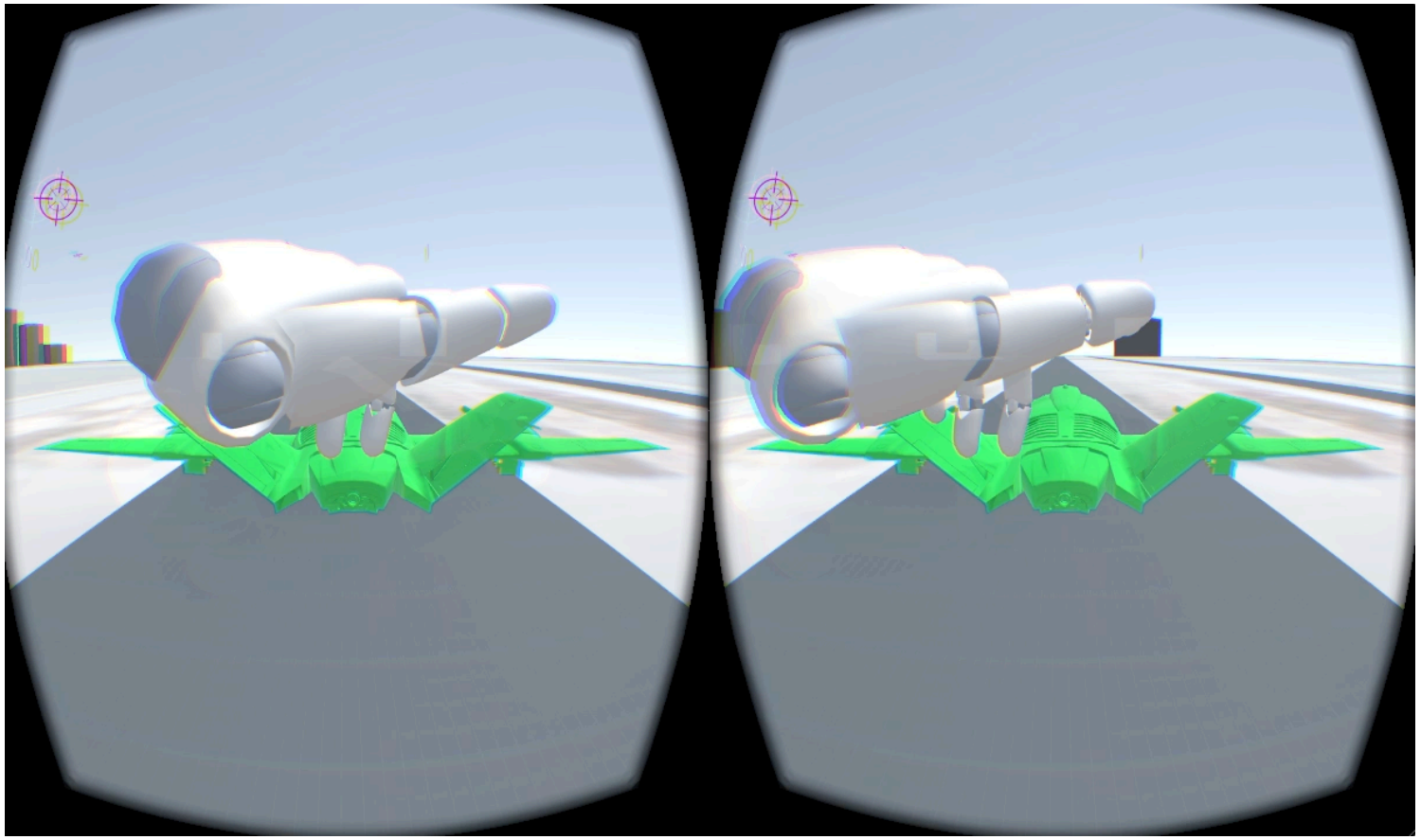

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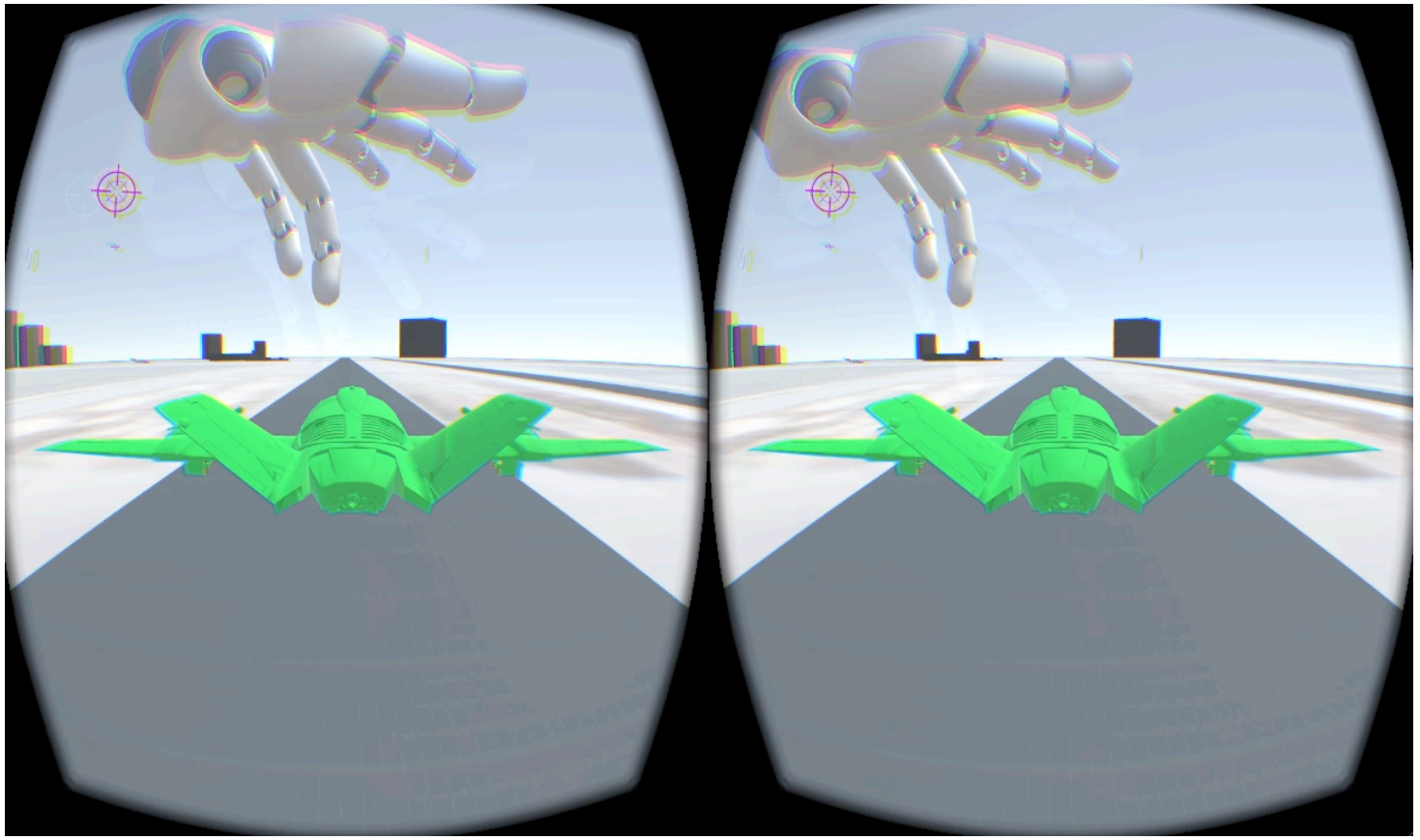

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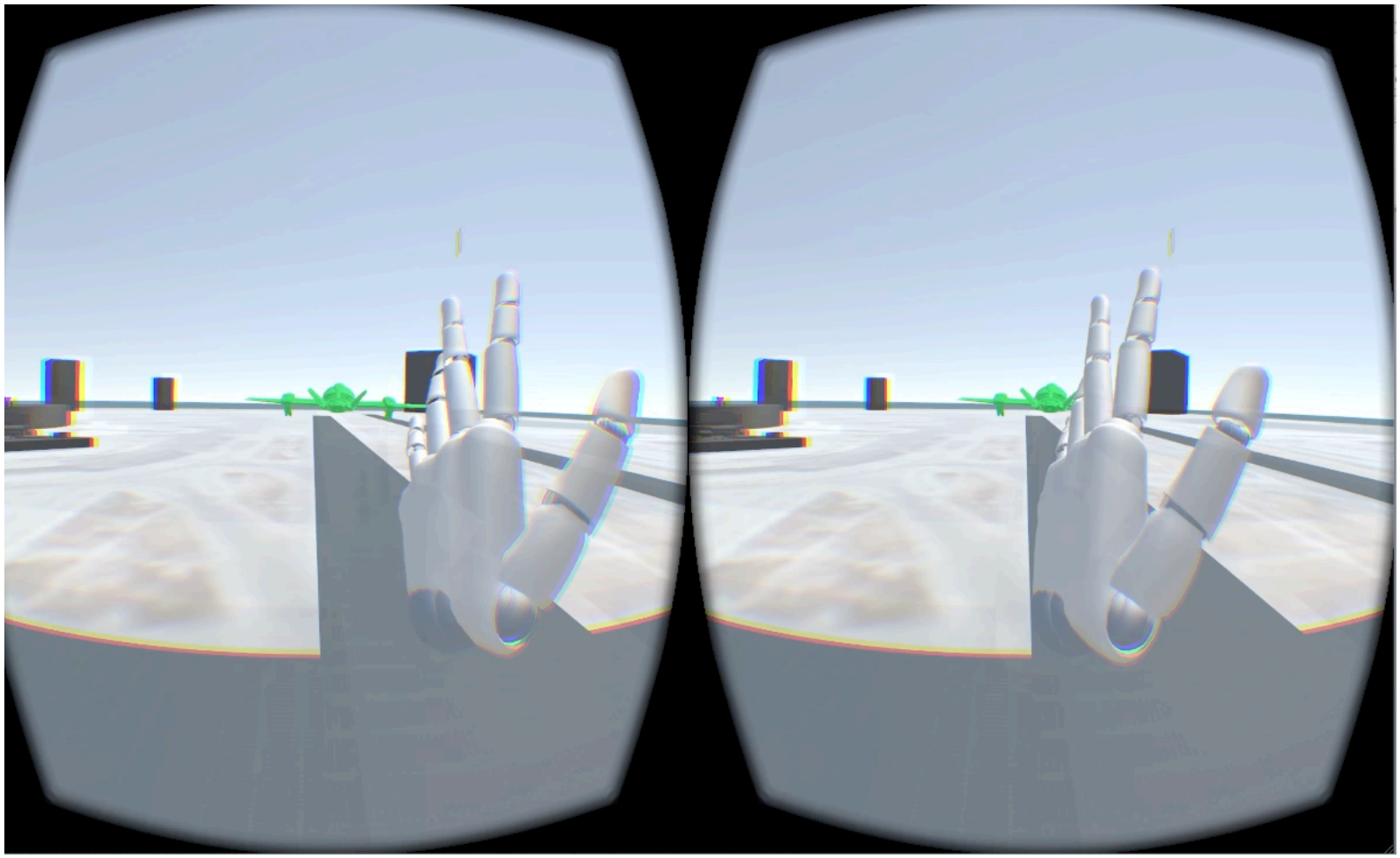

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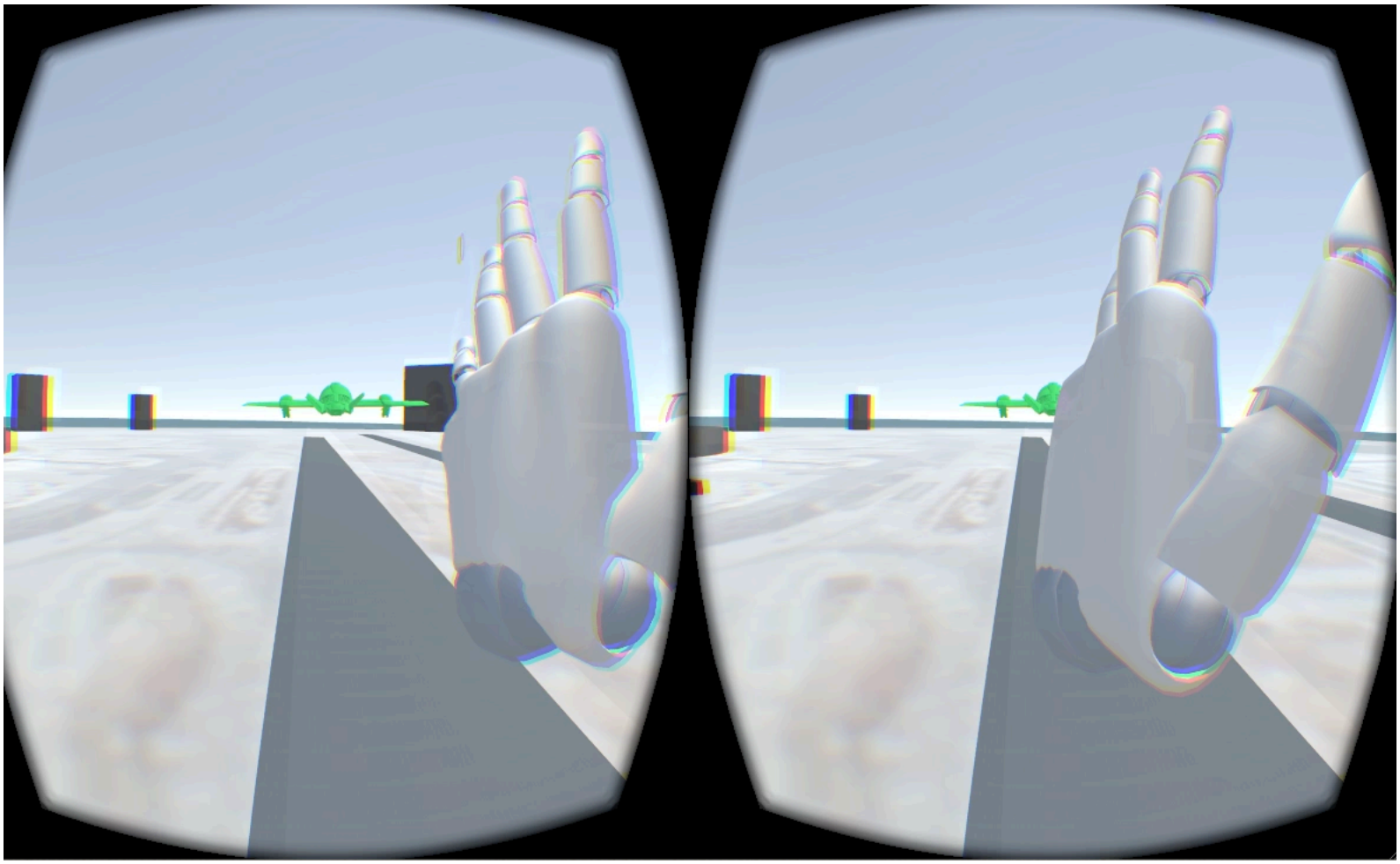

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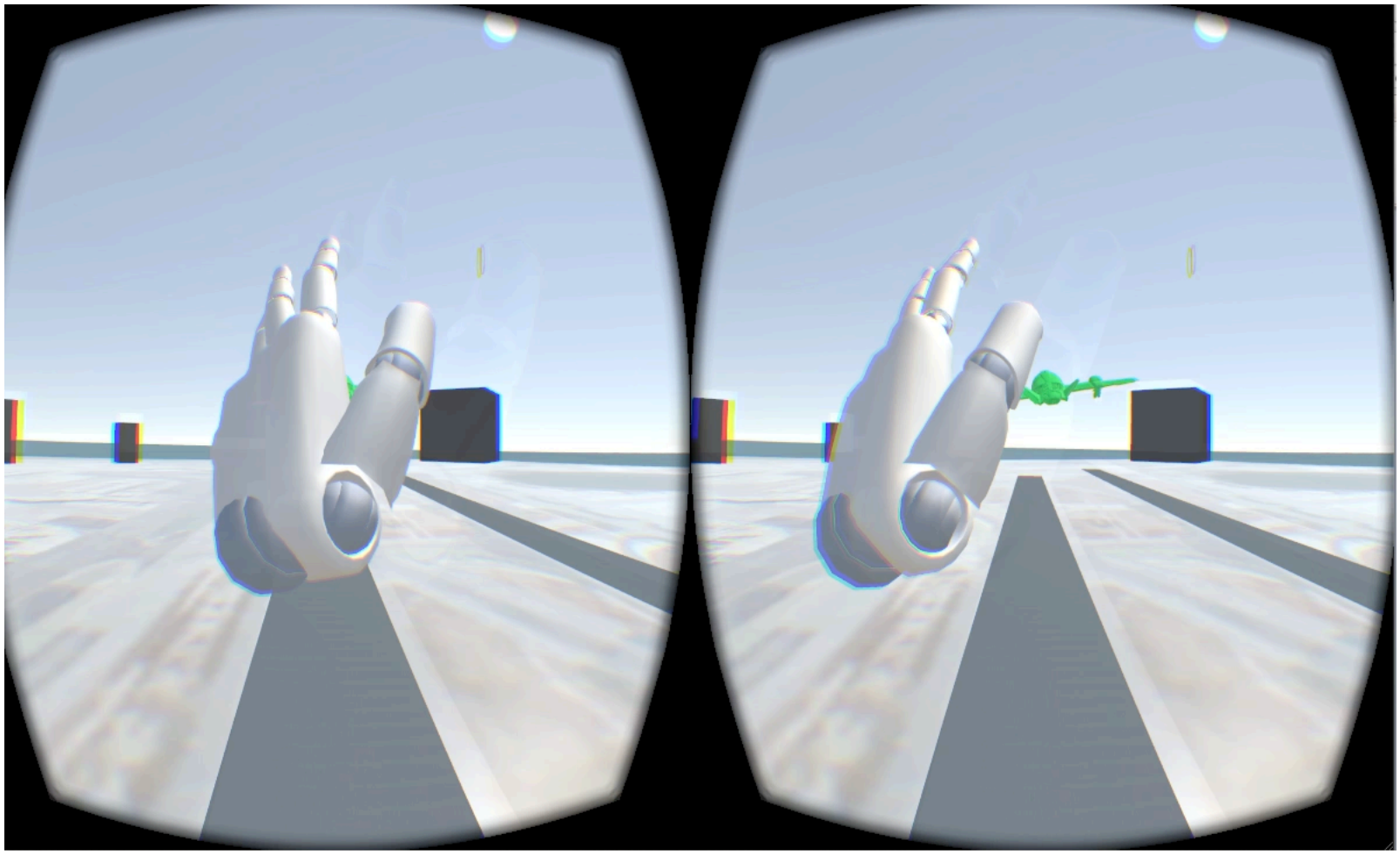

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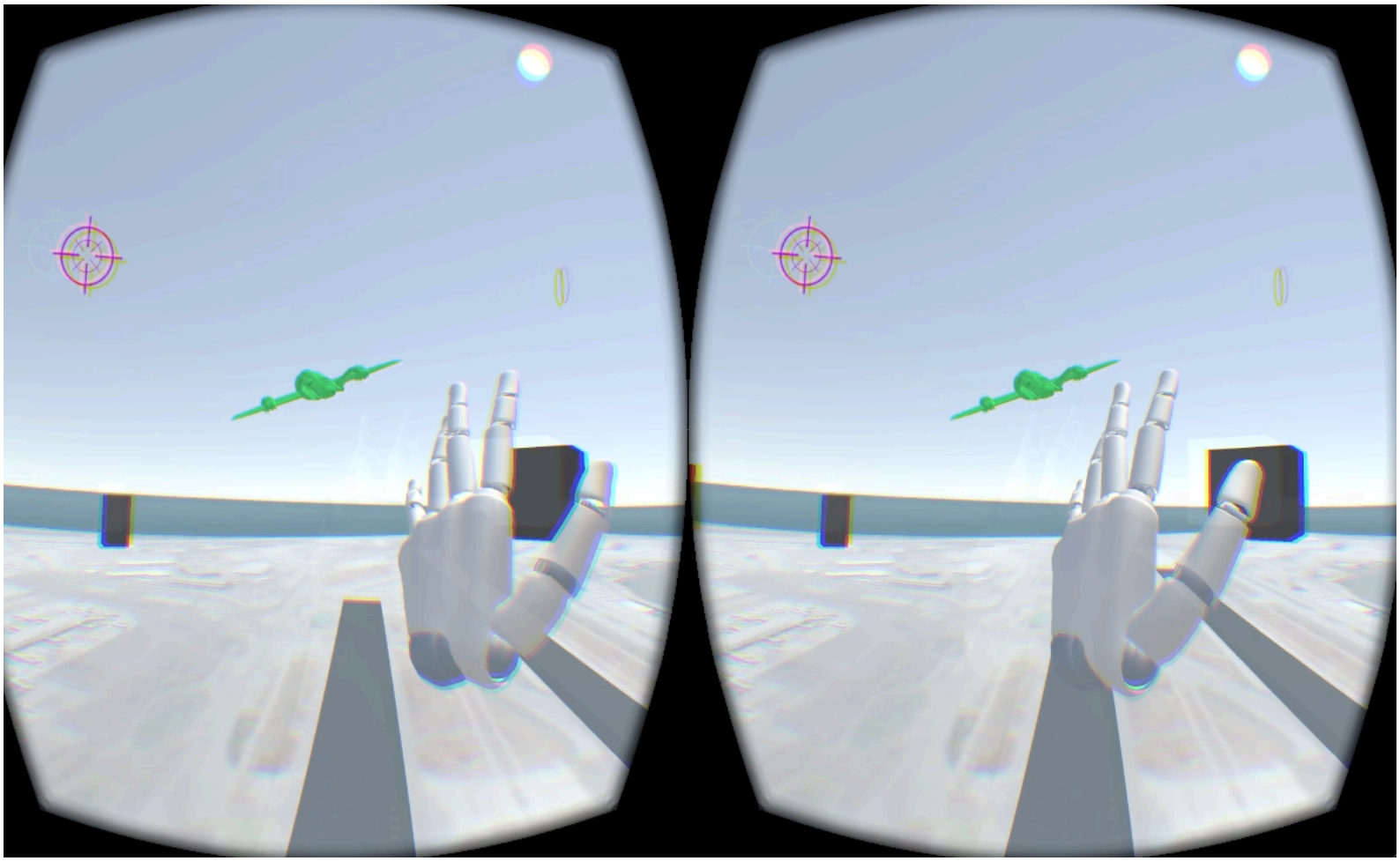

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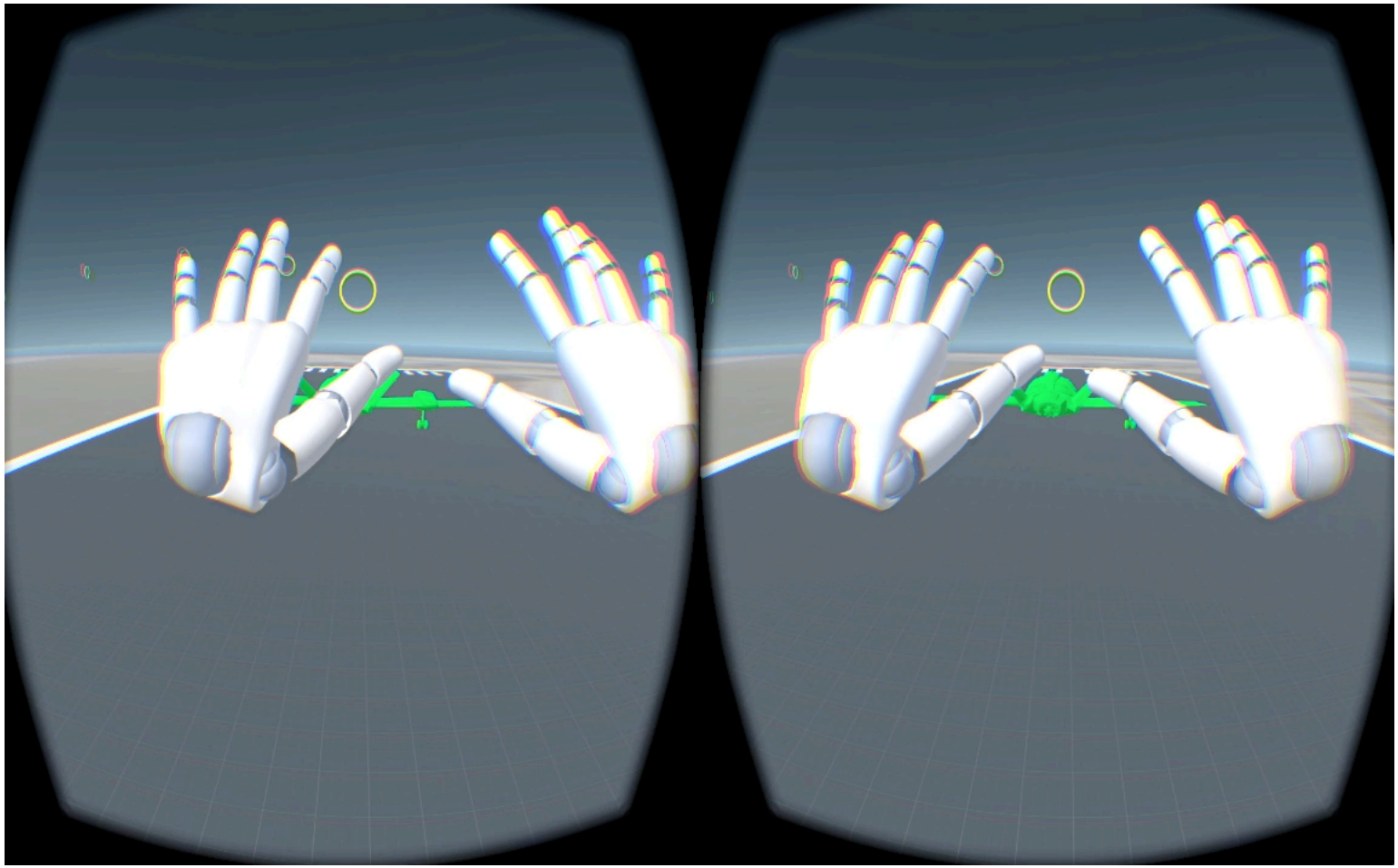

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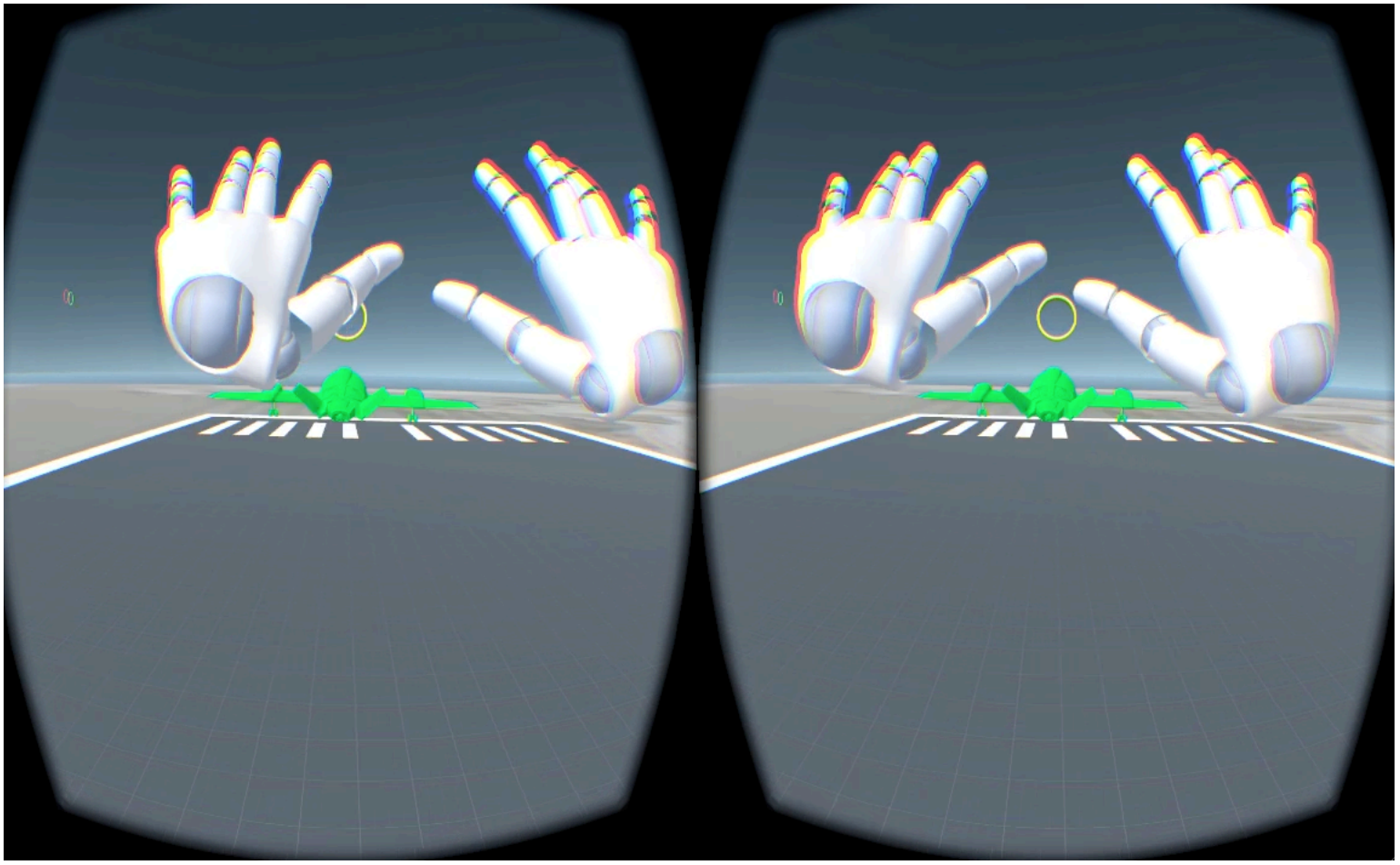

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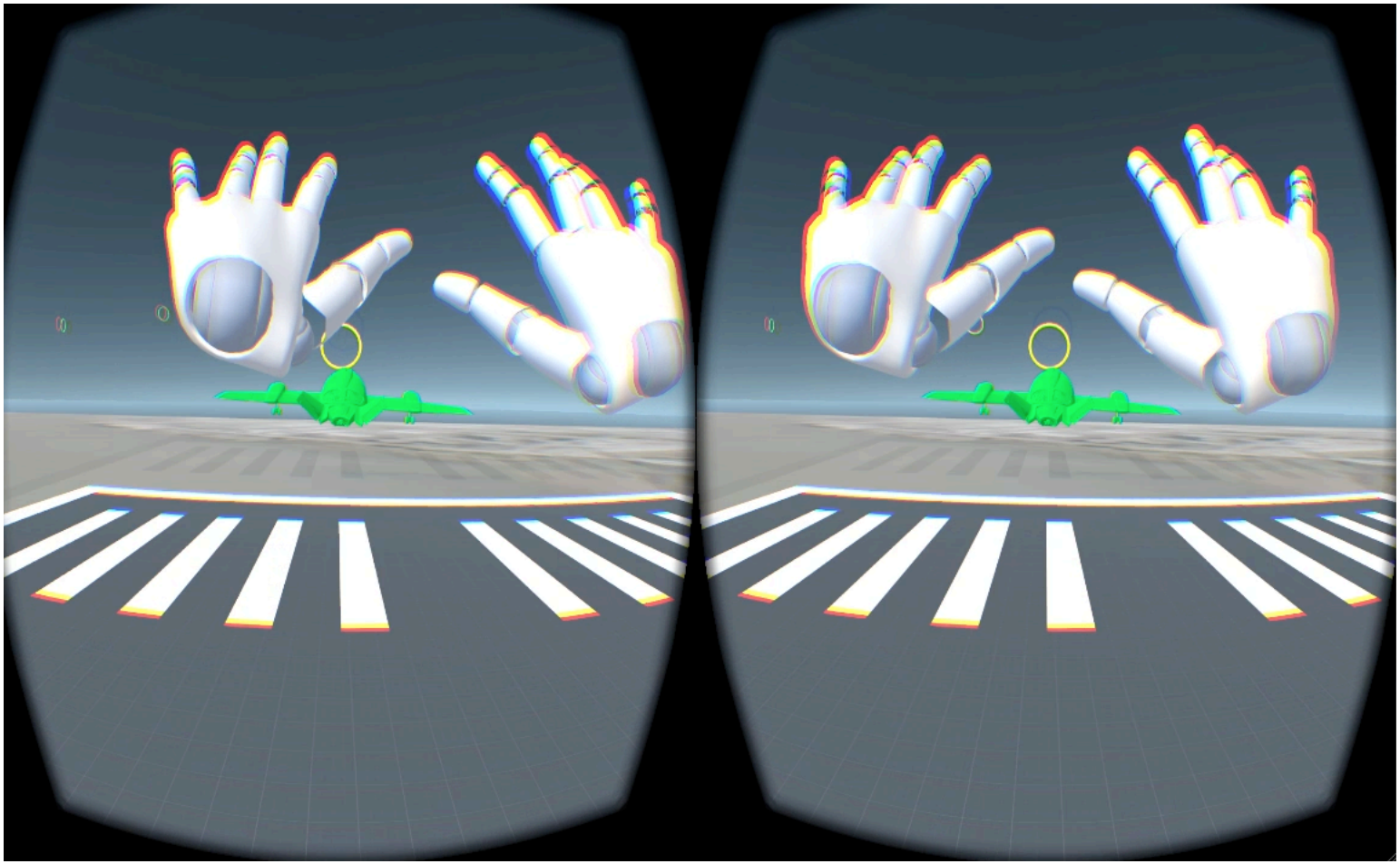
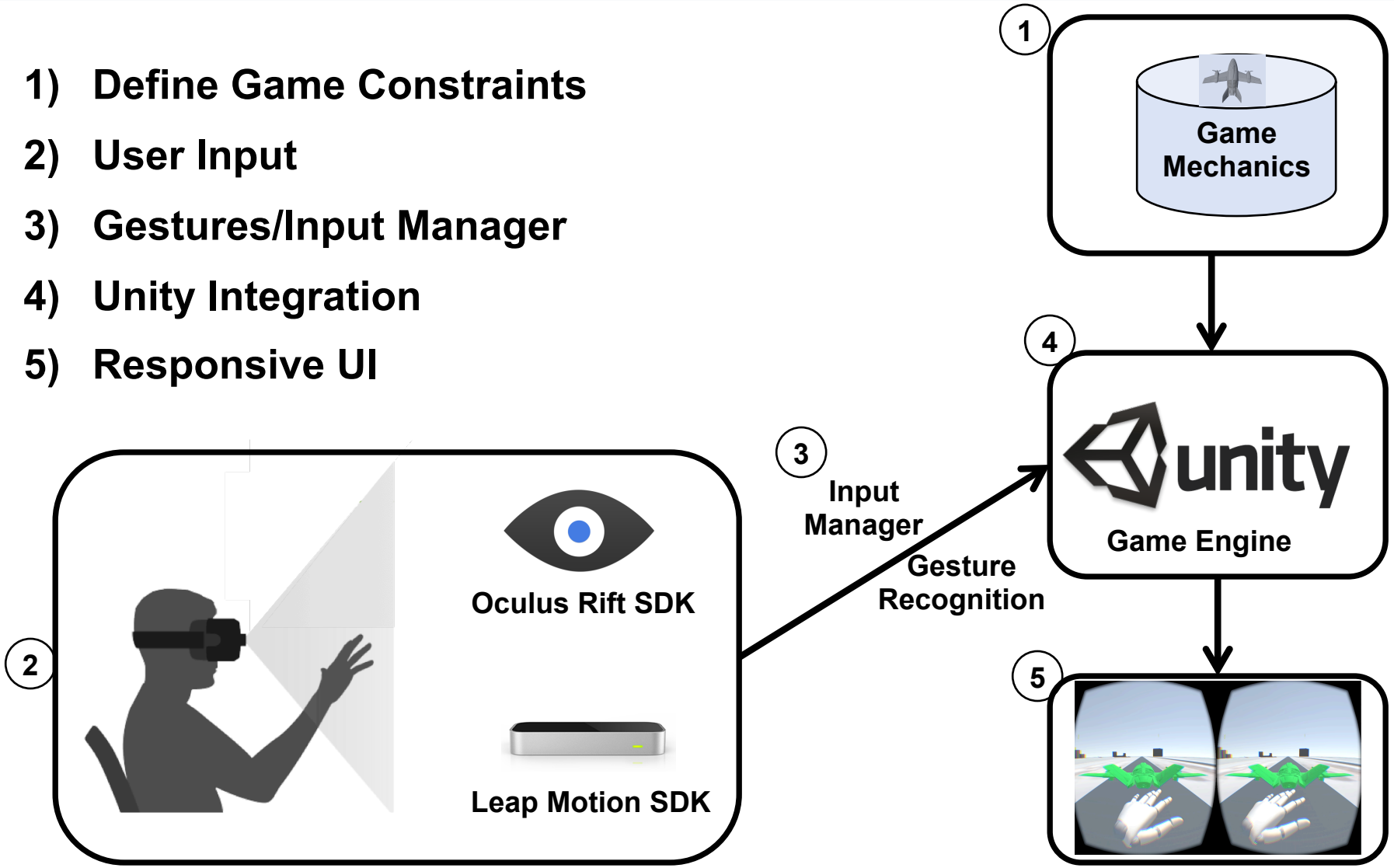


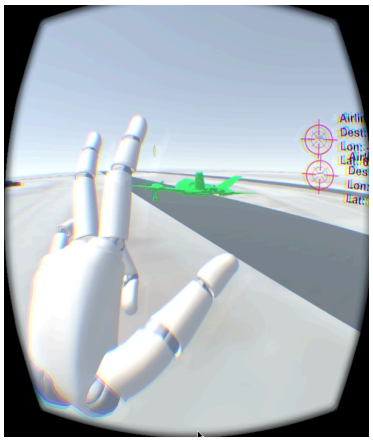
Architecture Overview

1) Define Game Constraints
2) User Input
3) Gestures/Input Manager
4) Unity Integration
5) Responsive UI



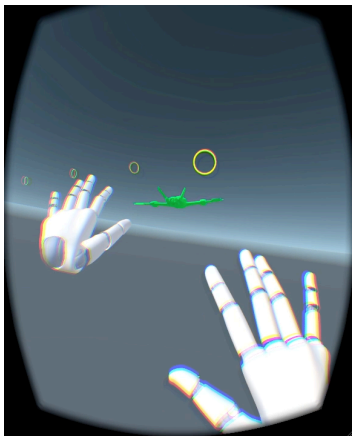
Evaluation

- **Field Training**



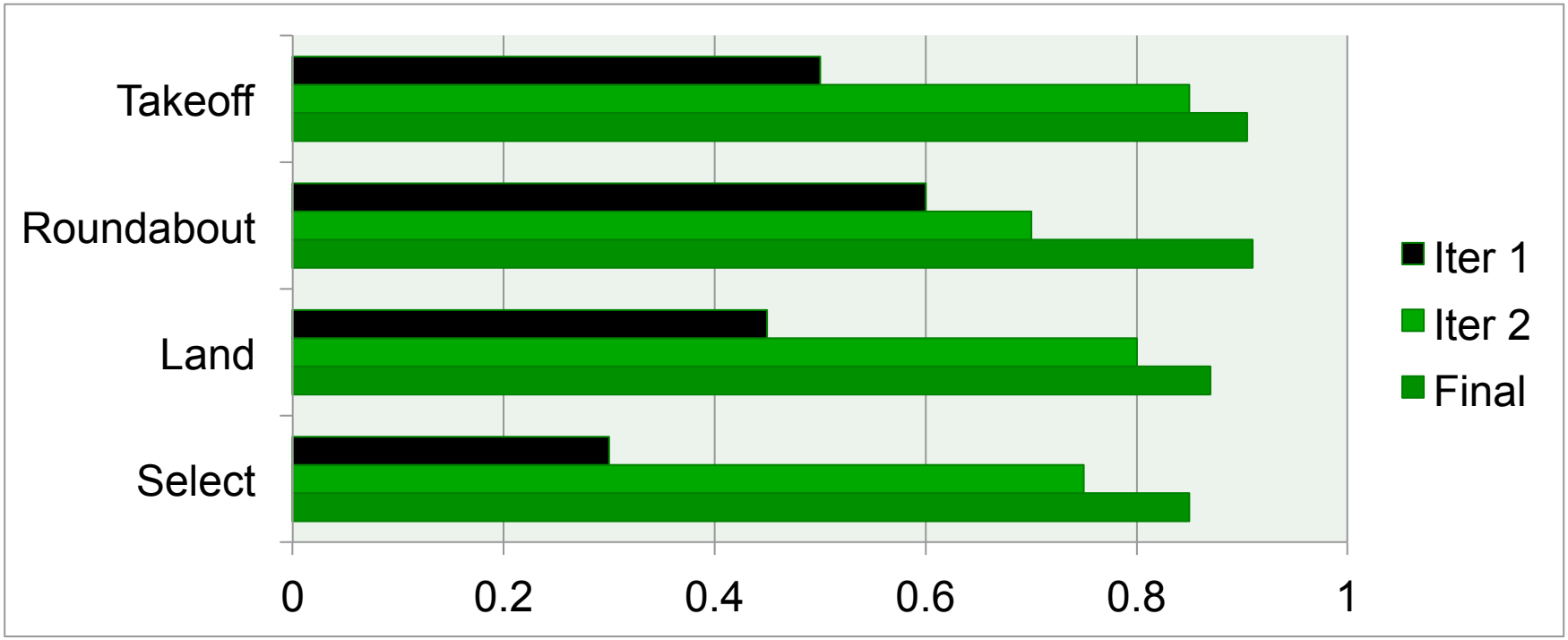
- **Gestures**
  - **Takeoff, Roundabout, Land**
  - **Camera Switch**
    - **Remote Tower, Plane in Focus**
- **OTS Test Scenarios**

- **Manual Piloting**



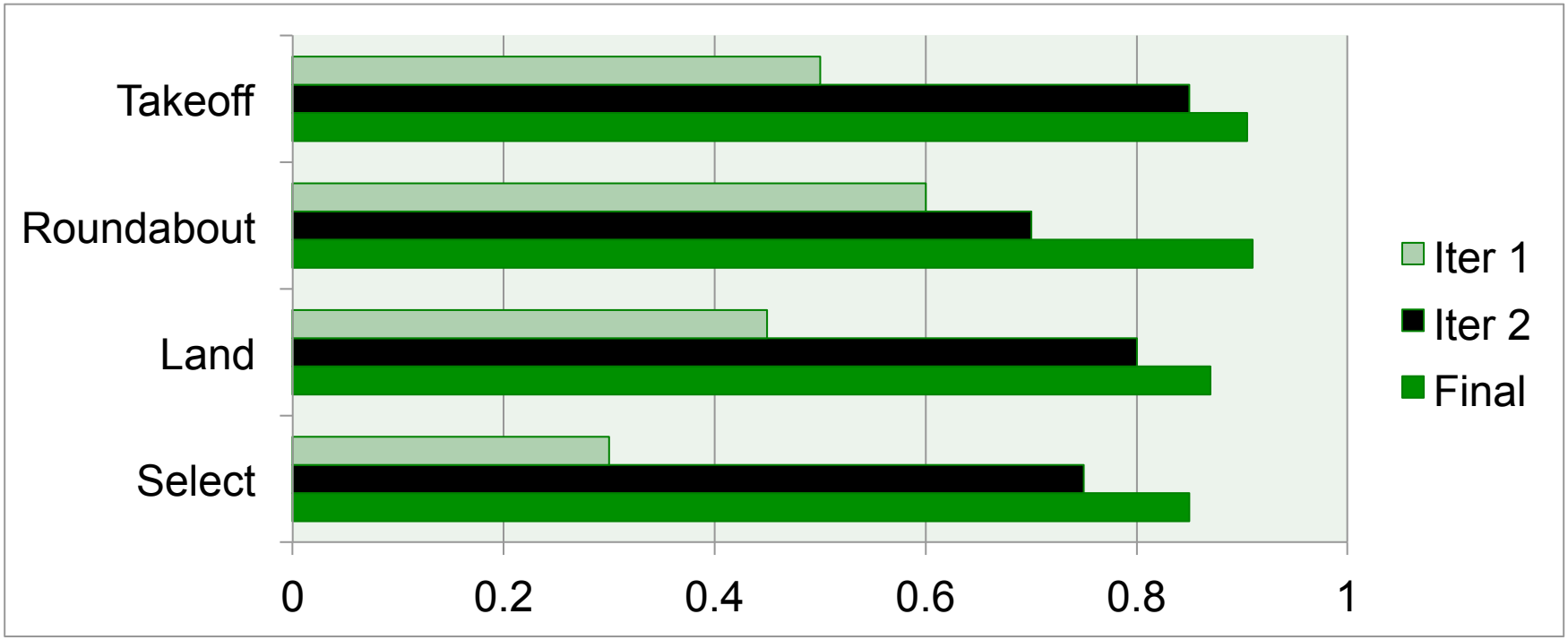
- **Gestures**
  - **Enabled/Disabled**
  - **Adjust Navigation**
    - **Yaw, Pitch, Roll, Thrust**
- **Timed Obstacle Course**

MP Performance: Gestures



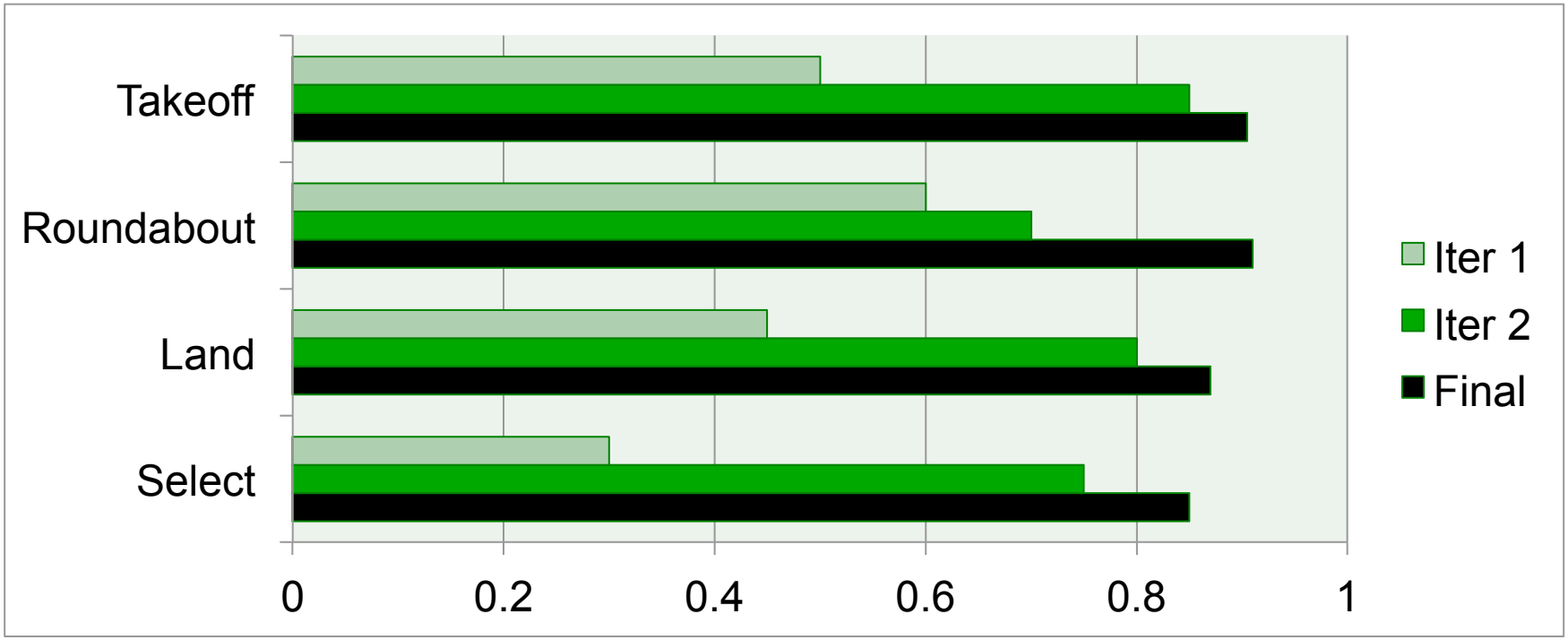
- **Status**
  - **Default Configurations**
  - **Leap SDK**
- **Limitations**
  - **Raycast from finger direction**
  - **Multiple gestures recognized**

MP Performance: Gestures



- **Status**
  - **Raycast from finger location**
  - **Direction**
  - **Speed**
- **Limitations**
  - **Transitioning btw gestures**
  - **Relative location of gestures**

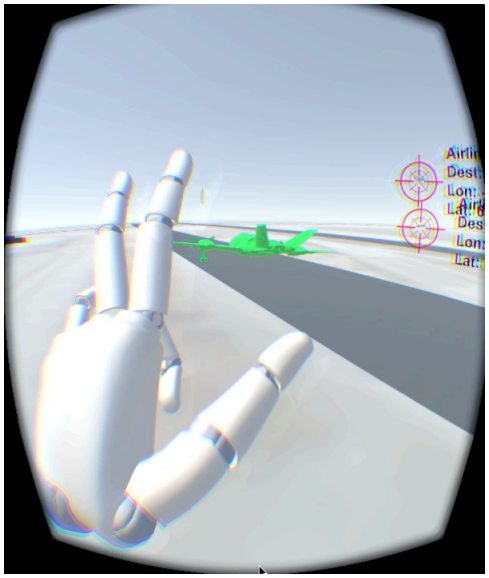
MP Performance: Gestures

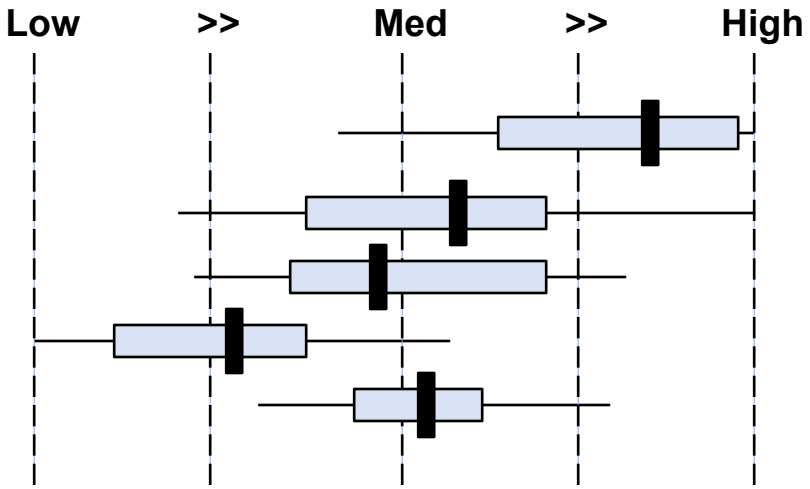


- **Status**
  - **Stabilization**
  - **Separation**
  - **Increase collider size**
- **Results**
  - **Accuracy > .85**

FT Performance: Usability

- OTS Test Scenarios
  - Simple Tasks (Select/Takeoff)
  - Attentiveness
  - Plane Coordination
  - Multiple tasks
  - Performance/Intensions

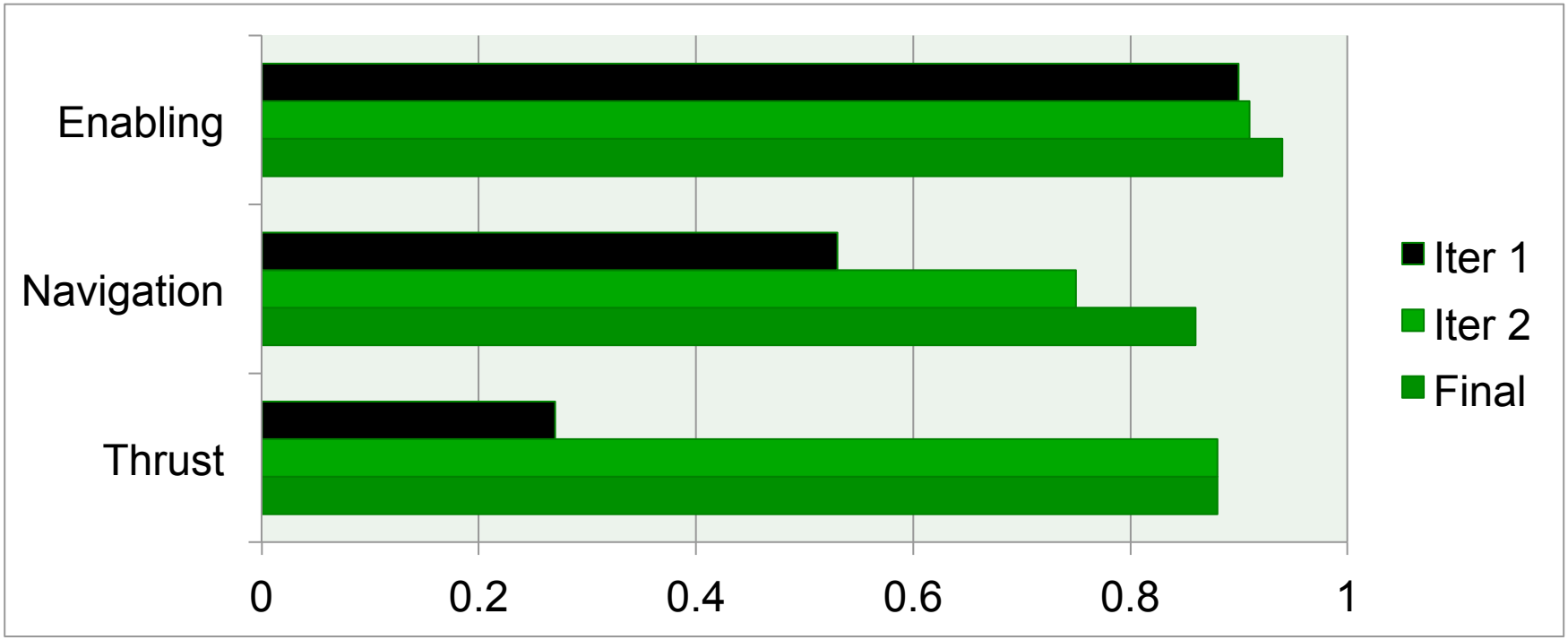




*Study for 4 participants/10 trials ea.

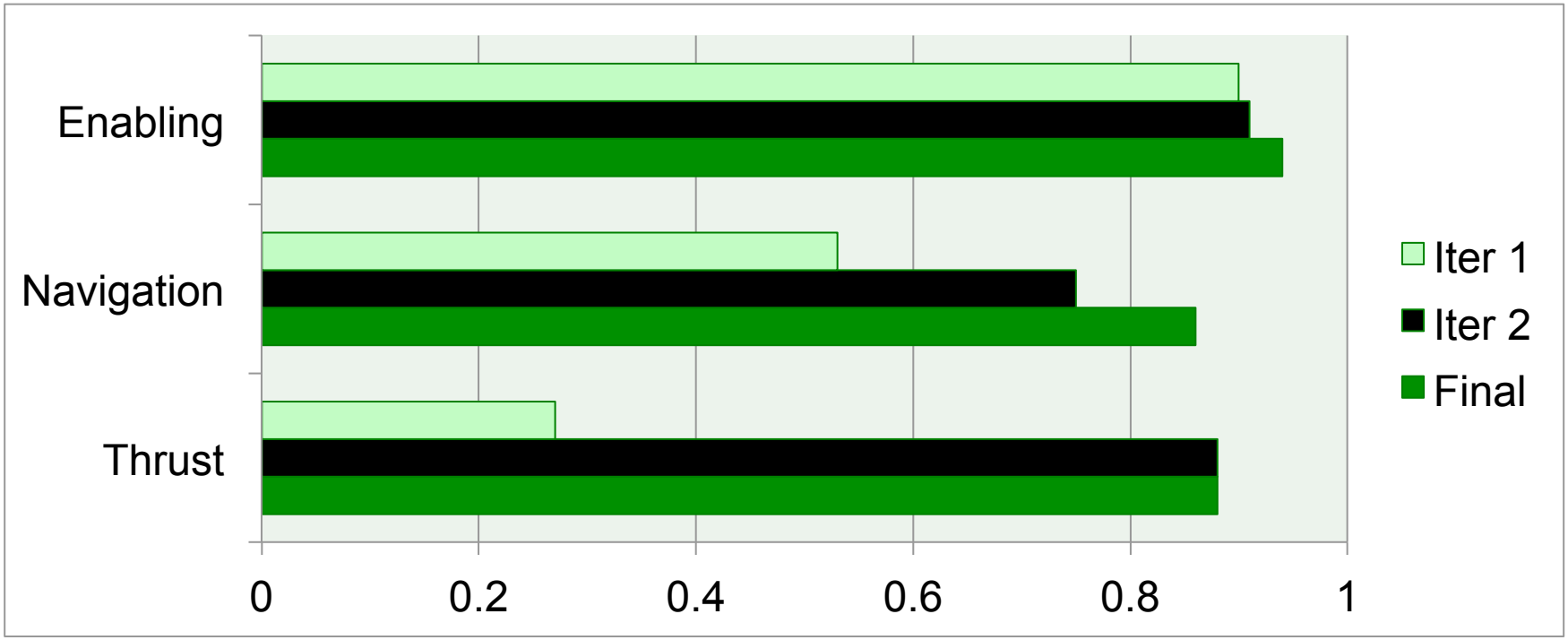
- "I know where *everything* is"
- "Am I doing this fast enough?"
- "Let me re-orient myself"

FT Performance: Gestures



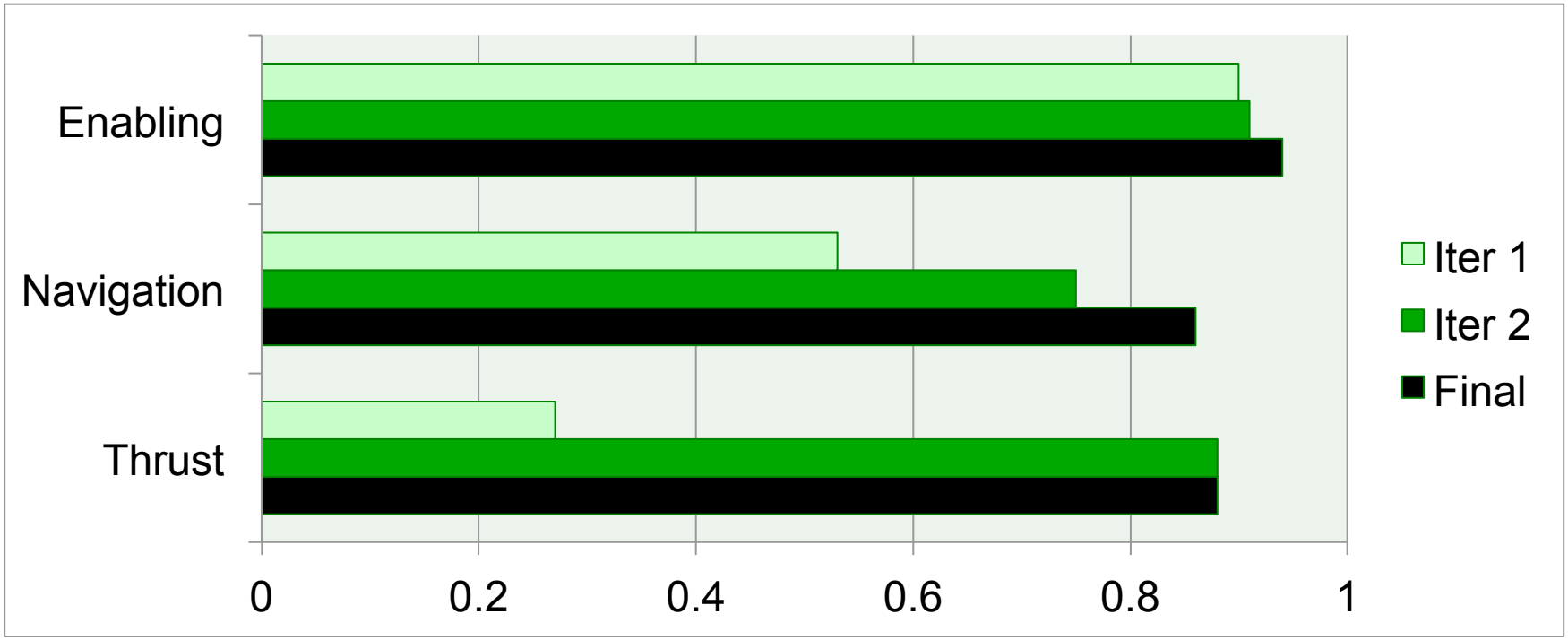
- **Status**
  - **Recognition of both hands**
  - **No constraints**
- **Limitations**
  - **Hand off screen / confidence**
  - **Trouble controlling thrust**

FT Performance: Gestures



- **Status**
  - **Interaction Box**
  - **Control thrust with fists**
  - **Speed**
- **Limitations**
  - **Trouble stabilizing**

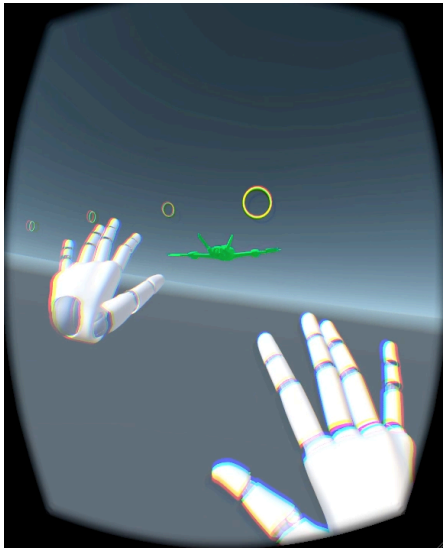
FT Performance: Gestures

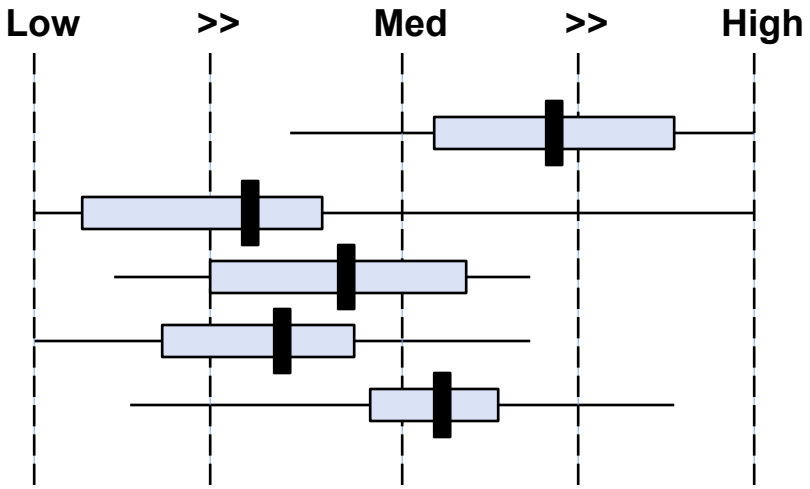


- **Status**
  - **Stabilization**
  - **Relative to origin**
- **Results**
  - **Accuracy >.89**

MP Performance: Usability

- **Timed Obstacle Course**
  - **Lap Duration**
  - **Average Speed**
  - **Waypoints Made**
  - **Time active**
  - **Performance Rate**





***Study for 4 participants/10 trials ea.**

- **"Cool, I got the hang of it"**
- **"Needs to be more forgiving"**
- **"Arms got tired"**
- **"*Slow and steady*"**

Final State/Discussion

- Created Immersive and Interactive ATC Simulation
- Two phase system
  - Management - Field Training from ATC tower
  - Direct Control - Manually Piloting a plane
- Very simple levels/scenes
- Effective Input Manager and Gesture Recognition

- Pros
  - Situational Awareness
  - Remote Tower Control
    - Low visibility
    - Obstructed Views

- Cons
  - Multi-tasking
  - Stereoscopic view
  - Visual Overload
  - Realtime/Latency

Future Work

- MIT Lincoln Lab
  - ATC Simulators
  - ATC Contacts
- Multi-dimensional scenarios
- Plane API
  - Plane finder, flight aware
- Add Speech
- More Features/Gestures