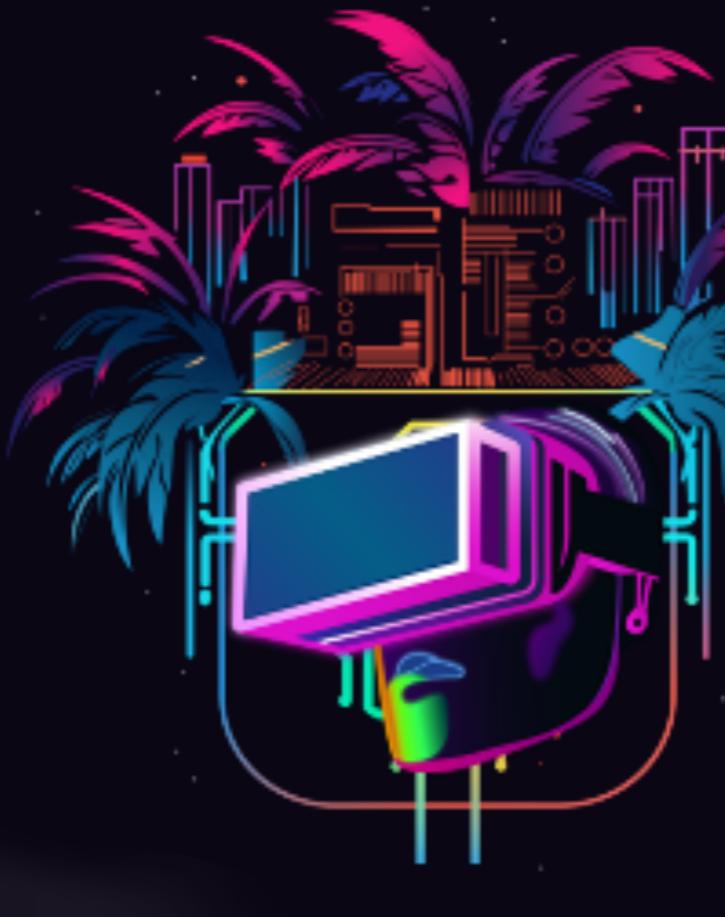


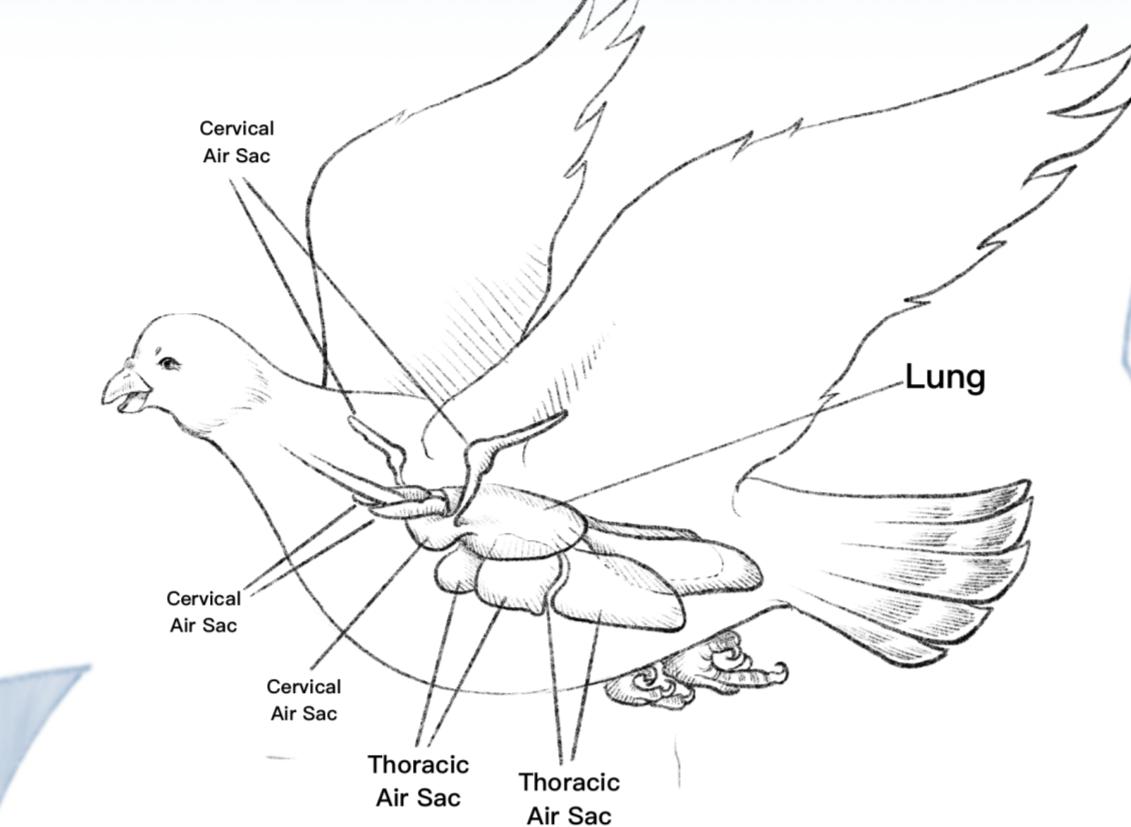
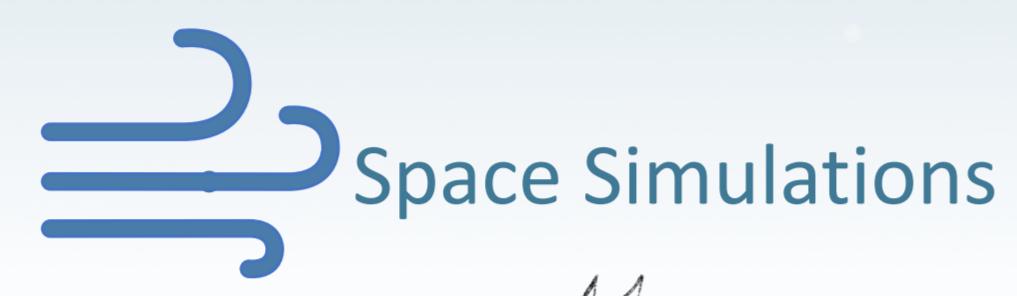
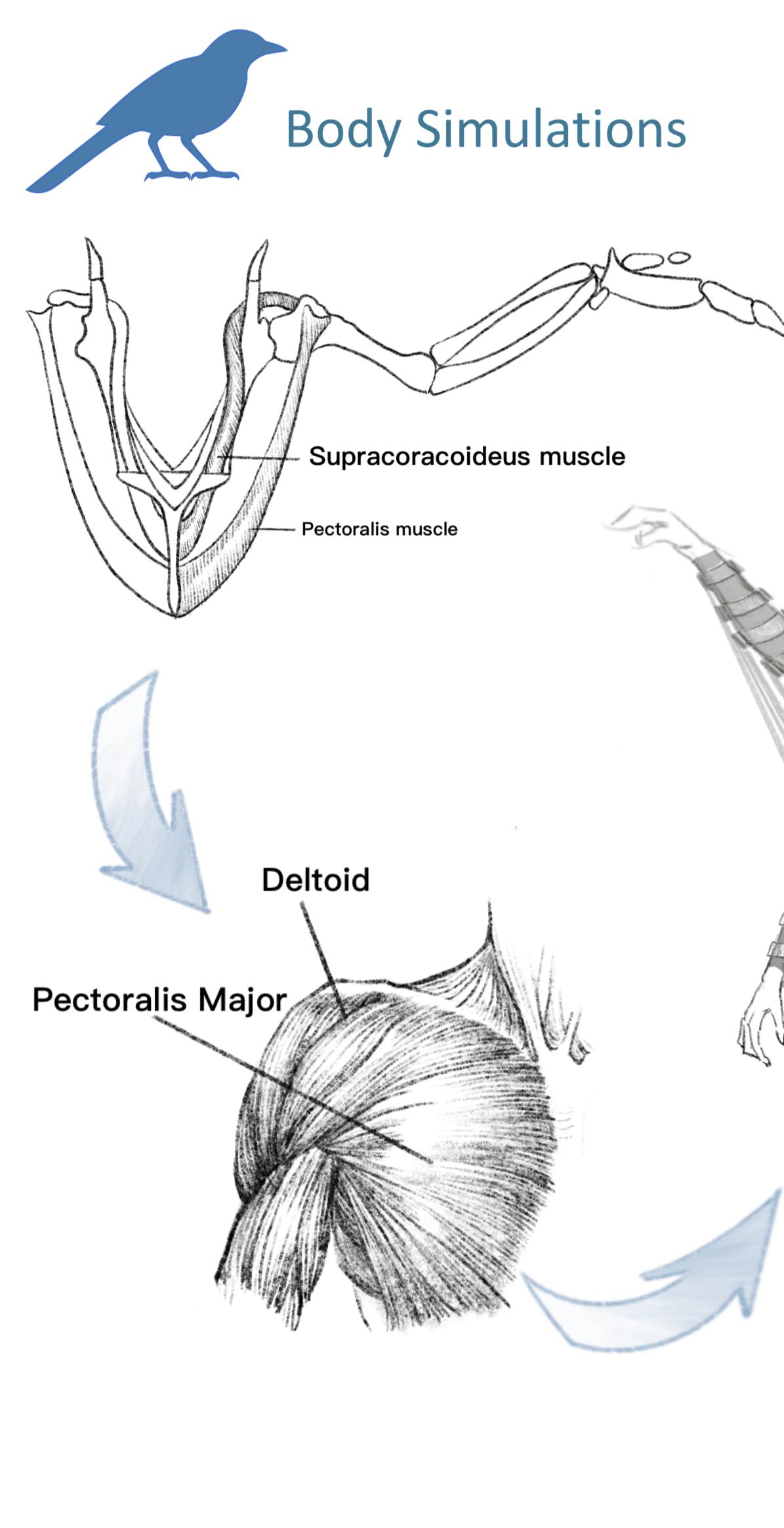
# Enhancing Body Ownership of Avian Avatars in Virtual Reality through Multimodal Haptic Feedback



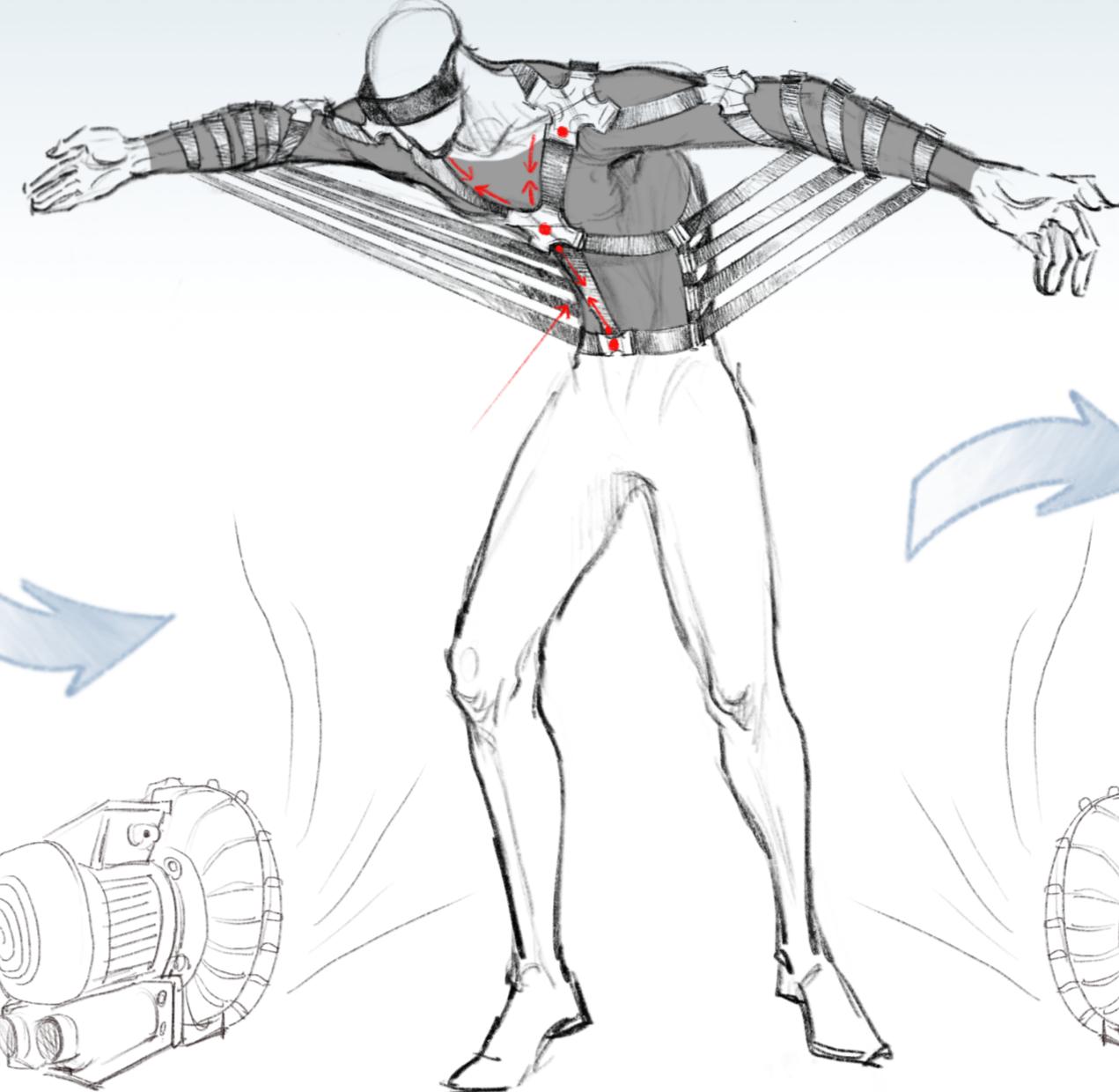
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Altitude  
Low → High

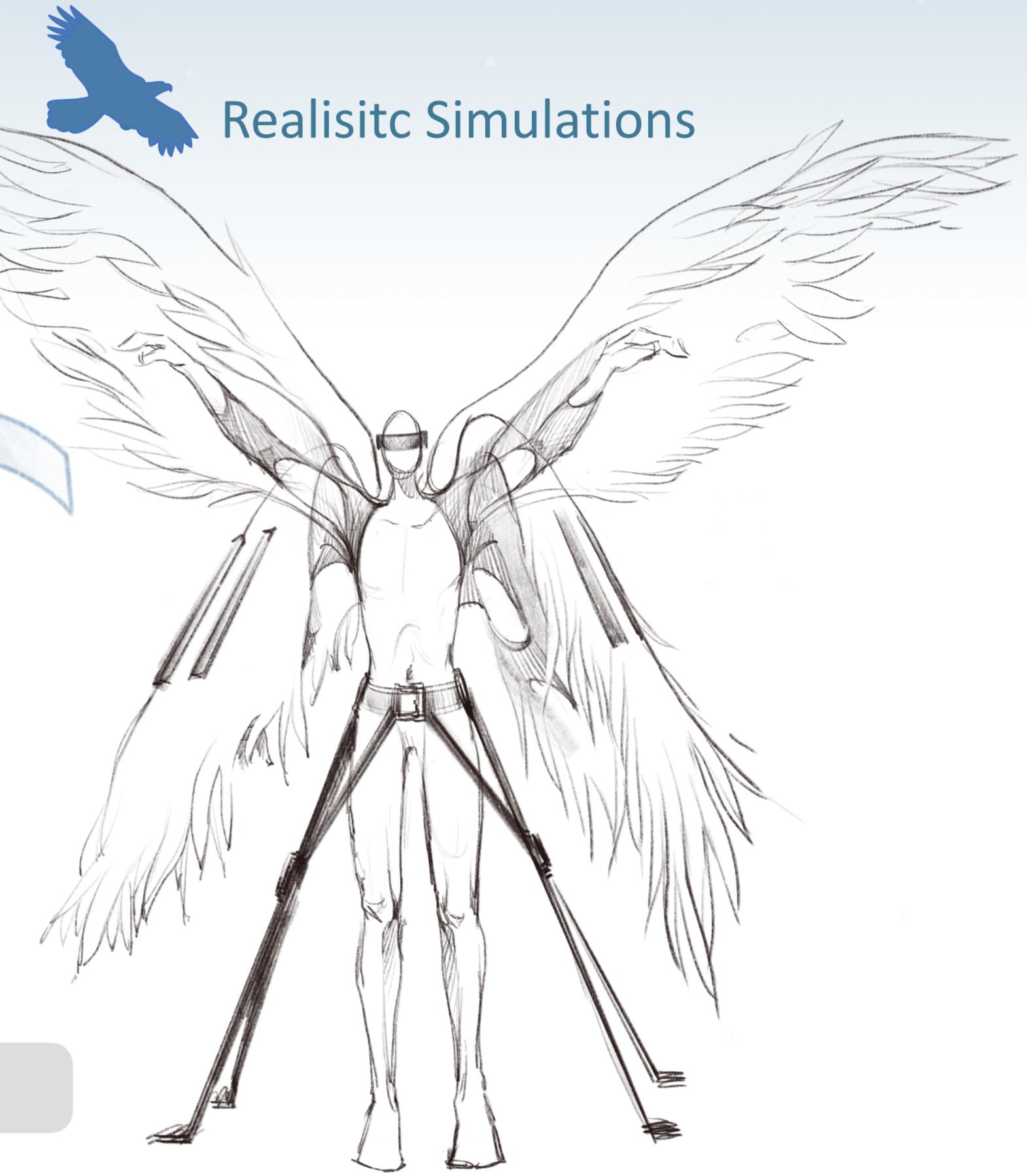


Body Simulation

- Retractable straps is activated
- Shorten the straps slightly
- Shorten the straps faster
- Preserve the status
- Release the straps

Keep flapping for 3s

- Activates avatar
- Bend forward and feels tension
- Tension is increased
- Bend lower and moves harder
- Reaching the end of the reel
- Breathe faster, feels cooler, tired
- Tension is decreased
- Stop flapping and stay for 10s



Realistic Simulations

User Start

Activate

Space Simulation

Space Simulation

- Inflatable airbag is activated
- Inflating
- Blowers activated
- Stop inflating
- Lower speed

## Abstract

This paper uses multimodal haptic feedback to enhance users' body ownership in virtual reality through wearable devices. In this case, the human is transformed into a bird, which belongs to the beyond-real transformations category in virtual reality interactions. For body transformation, wearable retractable straps can help people mimic the movement mechanism of avian bodies; for space transformation, the inflatable cushions and blowers can simulate the air resistance and lift, oxygen deprivation, and temperature decrease during the take-off process of avian avatars. The system aims to establish a realistic fidelity of the haptic feedback to enhance the user's body ownership.

## Contributions

1. This study develops a design methodology to enhance body ownership by simulating the movement mechanisms of non-human avatars through haptic feedback
2. After evaluating to find the combination of spatial and bodily haptic feedback devices with the highest score,
3. Enhancing the field's understanding of how space transformation interacts with body transformation in the beyond-real virtual reality. Establish a framework based on the effects of these interactions on body ownership.



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