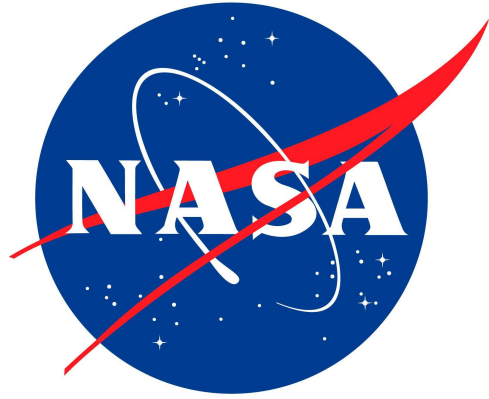




NASA Ames Simlabs

1

Maxim Mounier

Credit to Peter Zaal and Carla Ingram for some slide materials



Agenda

- NASA Ames Overview
- SimLabs Facilities
 - Vertical Motion Simulator
 - Research at VMS
 - Future Flight Central
 - Research at FFC
- My work at FFC



NASA Ames Research Center



VMS Building

Turkeys!!!





National Aeronautics and
Space Administration

SimLabs Facilities

Ames

Discovery • Innovations • Solutions

Unique facilities capable of a wide range of aerospace systems research

VMS



FFC



CVSRF





Vertical Motion Simulator - VMS



<https://images.nasa.gov/details/ARC-1997-ACD97-0410-18>

<https://images.nasa.gov/details/ARC-1997-AC97-0311>

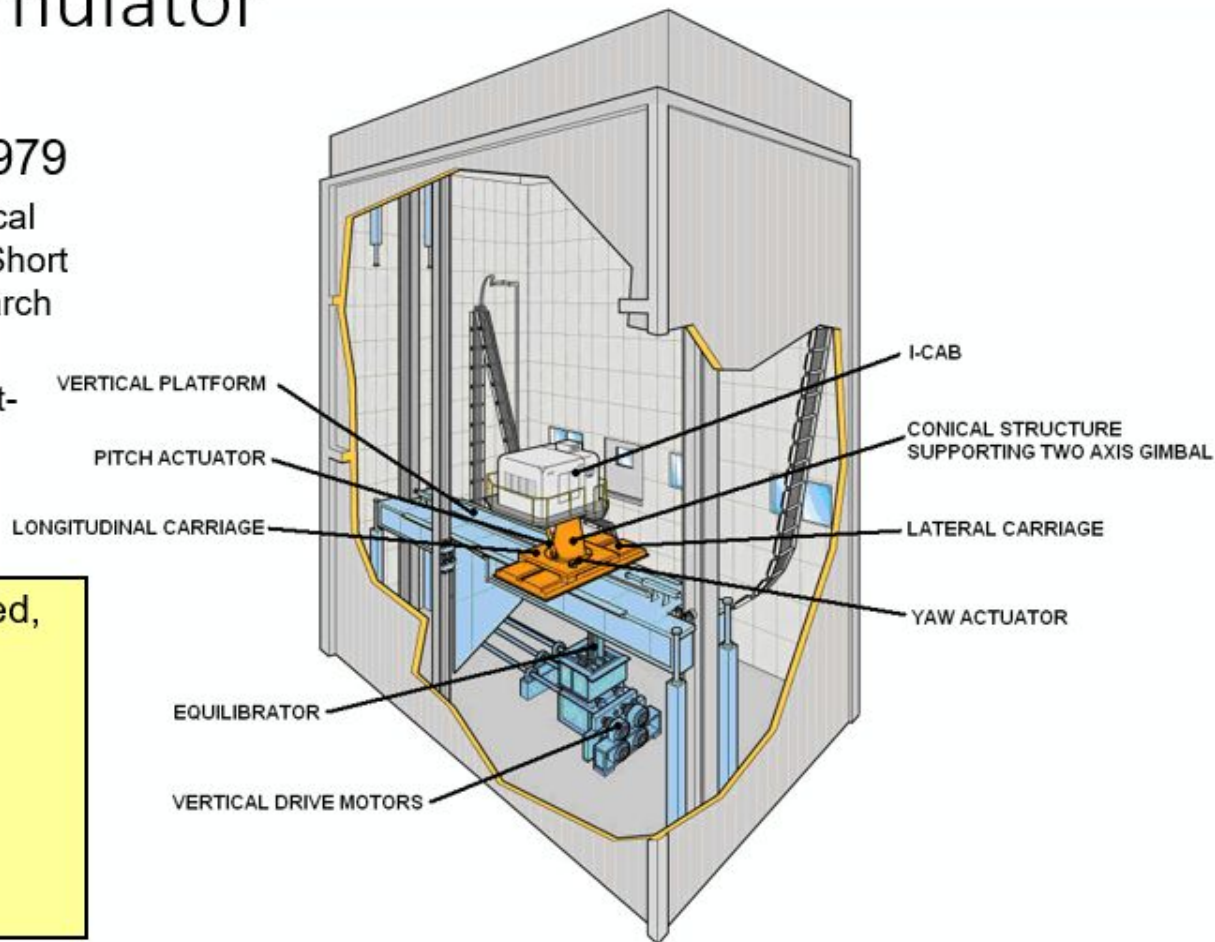
Vertical Motion Simulator

VMS was commissioned in 1979

- Originally designed to support Vertical Take-Off and Landing (VTOL) and Short Take-Off and Landing (STOL) research
- First simulation study was in 1980, investigating the Space Shuttle Pilot-Induced Oscillation (PIO) issue

335+ simulation studies conducted, primarily for research in:

- Handling Qualities of Aircraft and Spacecraft
- Flight Controls and Displays
- Simulation Fidelity
- Ride Qualities

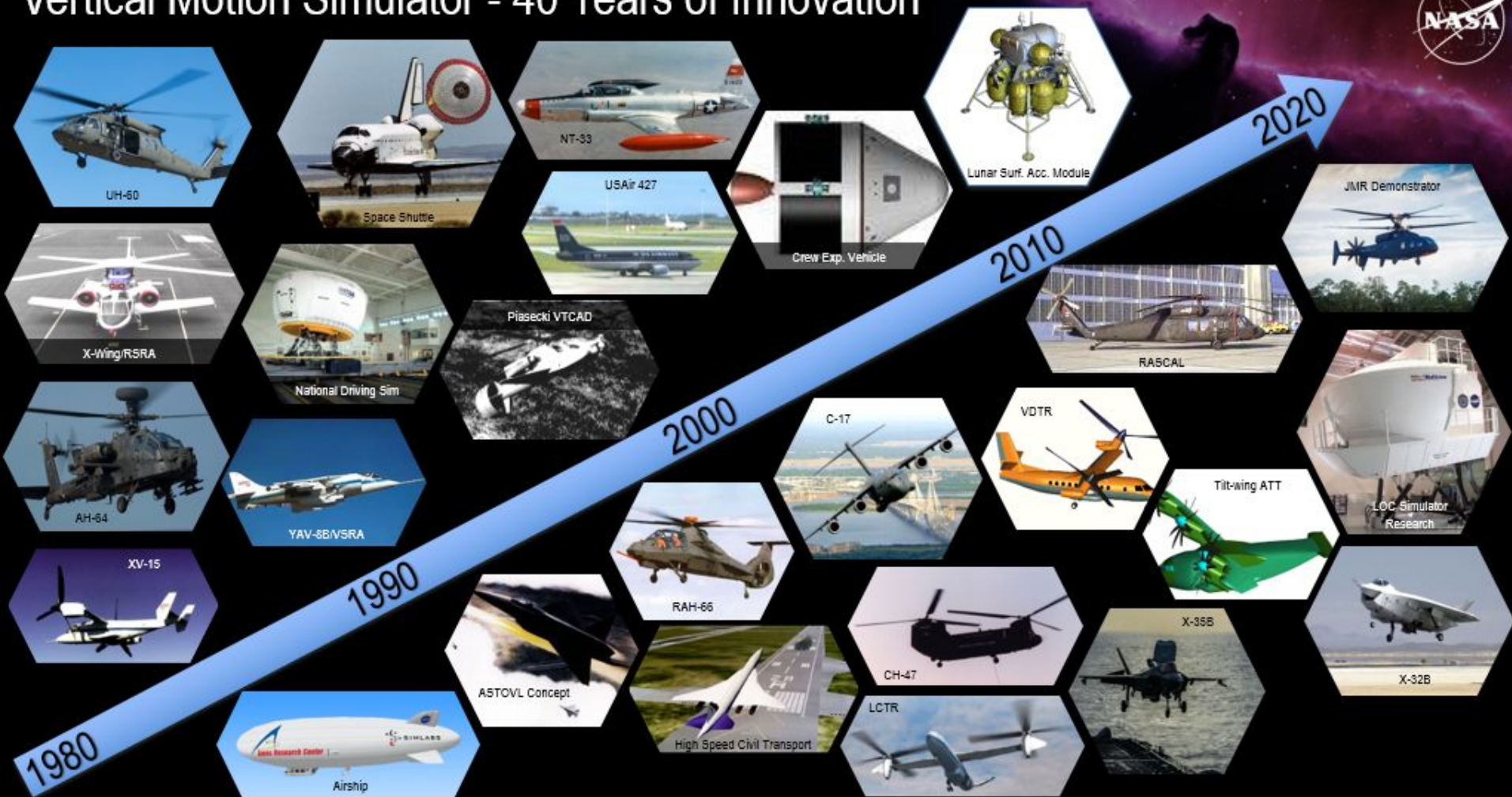


Vertical Motion Simulator Features

- Interchangeable cabs
 - Five cabs with varying visual fields-of-view and cockpit layouts
 - Programmable multi-function displays
 - Programmable force-feel systems with a variety of inceptors
- High-fidelity out-the-window visual systems
 - Wide-angle collimated display optics for improved depth perception
 - Customizable visual databases
- Flexible simulation architecture
 - Tailored to research applications
 - Accepts customer software and hardware modules
 - Two fixed-base labs for simulation development
 - Interactive Analysis and Display System
- Large-amplitude six-degree-of-freedom motion system



Vertical Motion Simulator - 40 Years of Innovation





Research at the VMS - Space Shuttle/HLS

<https://www.youtube.com/watch?v=0WaiAyU-3mU&t=88s>



Vertical Motion Simulator
at NASA's Ames Research Center
in Silicon Valley, California



Research at the VMS - AMP/AEP

Images for it on website:

<https://images.nasa.gov/details/ACD22-0036-007>





VMS Future Work

Using Human Mounted Devices (VR/AR) for research

- Applications:

- VR as a tool for experiment design
- VR to simulate large OTW views (e.g. in advanced air mobility vehicles)
- AR/VR for rapidly reconfigurable cockpits

- Research:

- Cybersickness

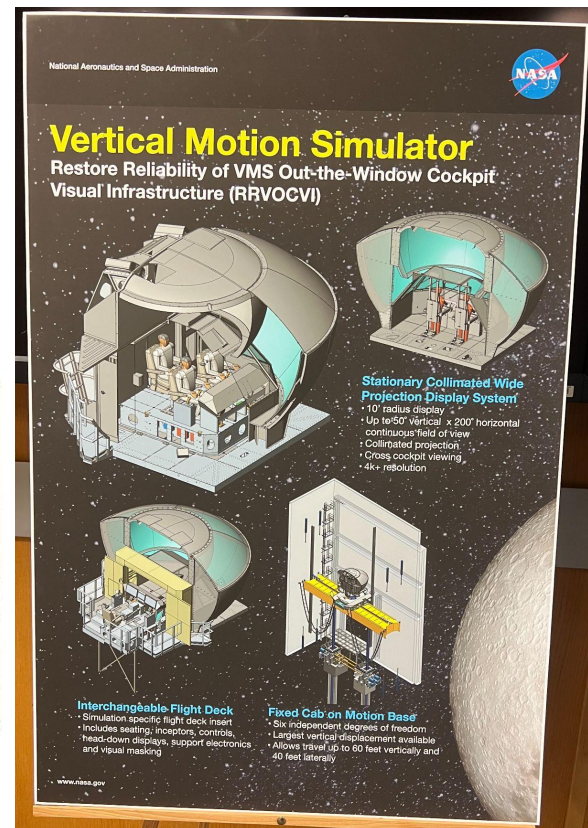
(Terenzi and Zaal, 2020, Rotational and Translational Velocity and Acceleration Thresholds for the Onset of Cybersickness in Virtual Reality, AIAA-2020-0171)

- Benchmarking VR for training

(Terenzi and Zaal, 2020, Comparing Virtual Reality to Conventional Simulator Visuals: Effects of Peripheral Visual Cues in Roll-Axis Tracking Tasks, AIAA-2020-0170)



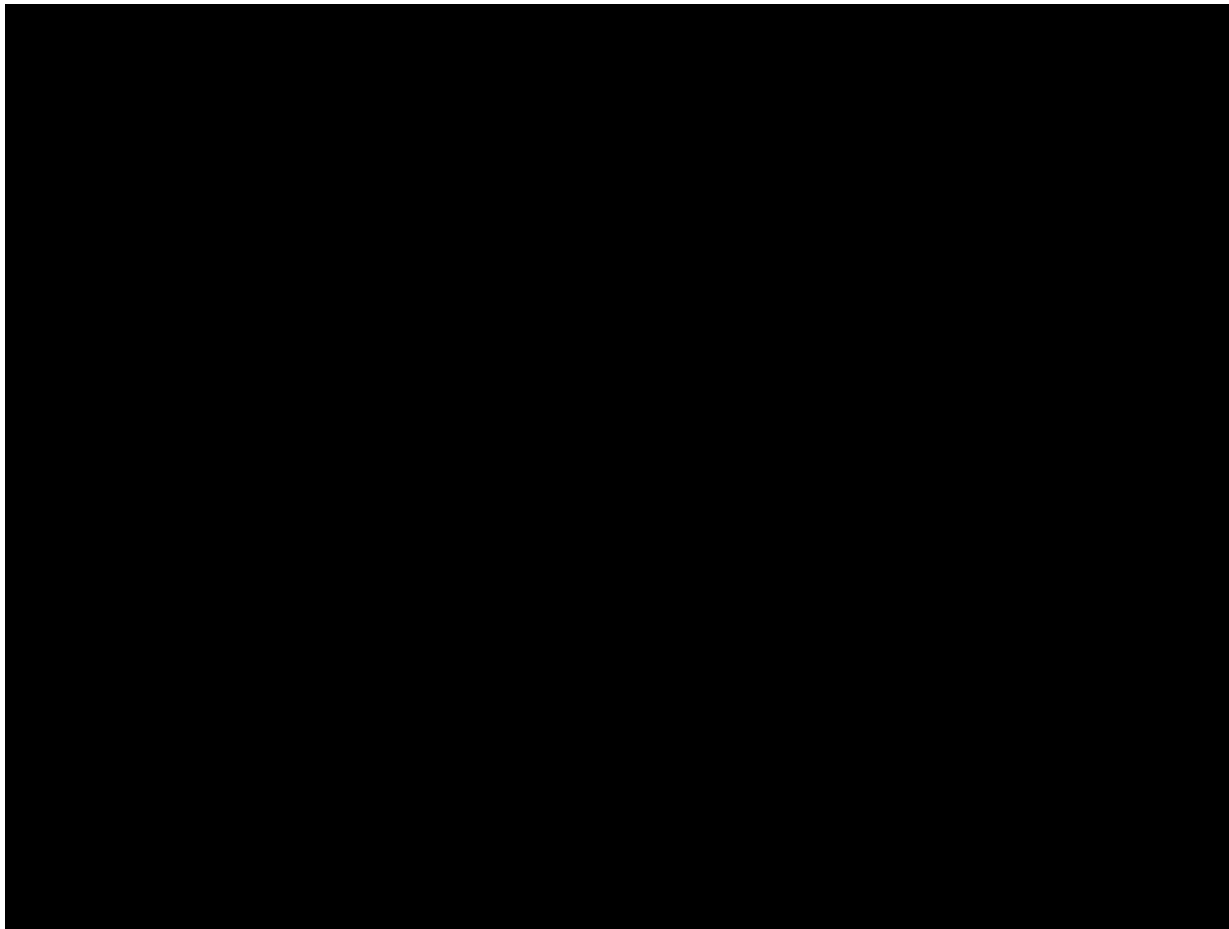
Dome Upgrade:





Future Flight Central - FFC



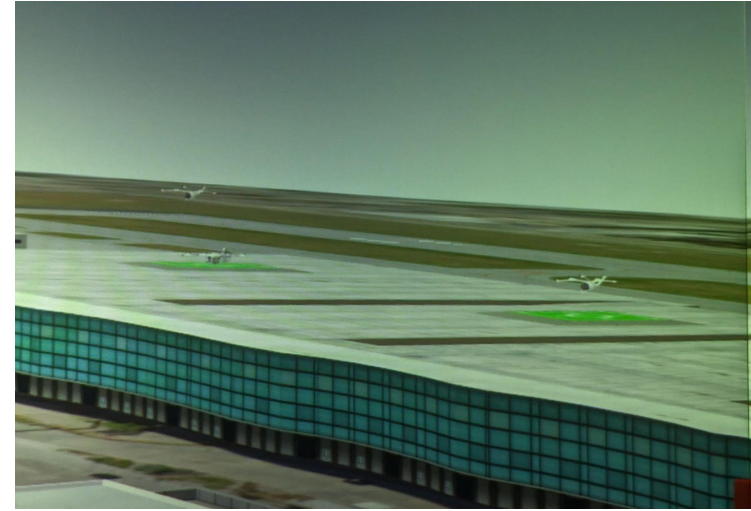


<https://images.nasa.gov/details/ARC-20161214-AAV2891-FFC-WinterWeather-GfxPkg-NASAWeb>



Research at FFC - Airspace Integration Study

Goal: Integrating VTOLs into airport airspace



<https://www.nasa.gov/simlabs/ffc/>



My Work at FFC



Visual System Upgrade - Dead Reckoning

-> Upsampling aircraft state data from low frequency (1Hz, 4Hz) to high frequency for visuals (100Hz)

-> Reworking code from a decade ago, fixing issues.

"Your team's producer decides that it's time to release a networked game, saying "We can publish across a network, right?" Bob kicks off a few internet searches and replies, "Doesn't look that hard." He dives into the code, and before long, Bob is ready to begin testing. Then, he stares in bewilderment as the characters jerk and warp across the screen and the vehicles hop, bounce, and sink into the ground. Thus begins the nightmare that will be the next few months of Bob's life, as he attempts to implement dead reckoning "just one more tweak" at a time."

<https://books.google.com/books?id=ujfOBQAAQBAJ&dq=%22Believable+Dead+Reckoning+for+Networked+Games%22&pg=PA307#v=onepage&q=%22Believable%20Dead%20Reckoning%20for%20Networked%20Games%22&f=false>

$$P_t = P_0 + V_0 T + \frac{1}{2} A_0 T^2$$

$$V_b = V_0 + (\dot{V}_0 - V_0) \hat{T}$$

$$P_t = P_0 + V_b T_t + \frac{1}{2} \dot{A}_0 T_t^2$$

$$\dot{P}_t = \dot{P}_0 + \dot{V}_0 T_t + \frac{1}{2} \dot{A}_0 T_t^2$$

$$Pos = P_t + (\dot{P}_t - P_t) \hat{T}$$

https://en.wikipedia.org/wiki/Dead_reckoning#For_networked_games



The Moon @ FFC!!

