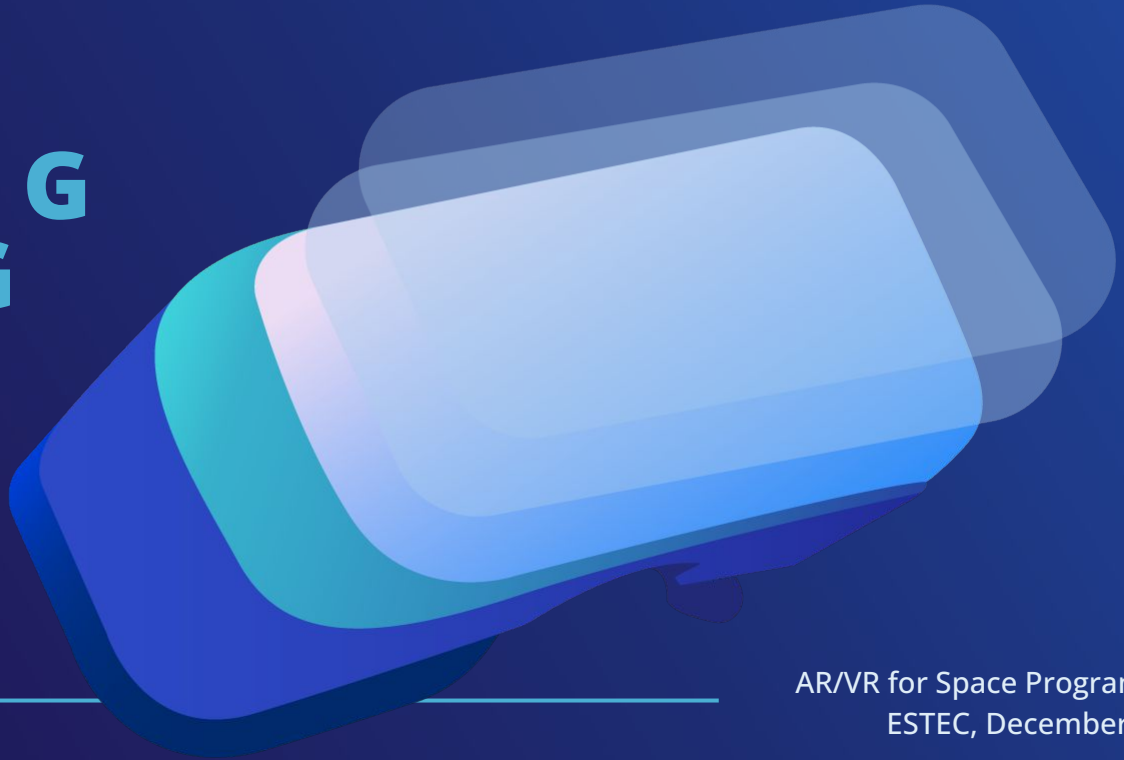
PaleBlue

VR & XR FOR ZERO G TRAINING



Felix Gorbatsevich
PaleBlue CEO

AR/VR for Space Programmes
ESTEC, December 2023

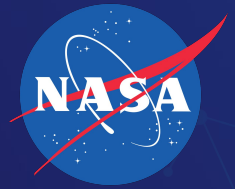
PaleBlue

IMMERSIVE TRAINING

We enable world's best digital training with best-in-class tools and platform from PaleBlue

OUR TECH POWERS TRAINING SUBSEA, IN SPACE, AND AROUND THE WORLD

CLIENTS & PARTNERS



VR Habitat training for NASA Johnson Space Center:
NASA Extreme Environments Missions Habitat

CLICKABLE VIDEO

Planetary VR Training
ESA Moon Village Concept

CLICKABLE VIDEO

VOGUE: Virtual Reality 0 G User Experience
VR System for Astronaut Training

WORKING WITH ASTRONAUTS

Luca Parmitano and **Samantha Cristoforetti** are seasoned astronauts who guided PaleBlue in the development of the VR training system.

ESA class of 2022

TRAINING ASTRONAUTS

Sławosz Uznanski
Astronaut

Latest training on PaleBlue system:
November 2023

Marcus Wandt
Astronaut

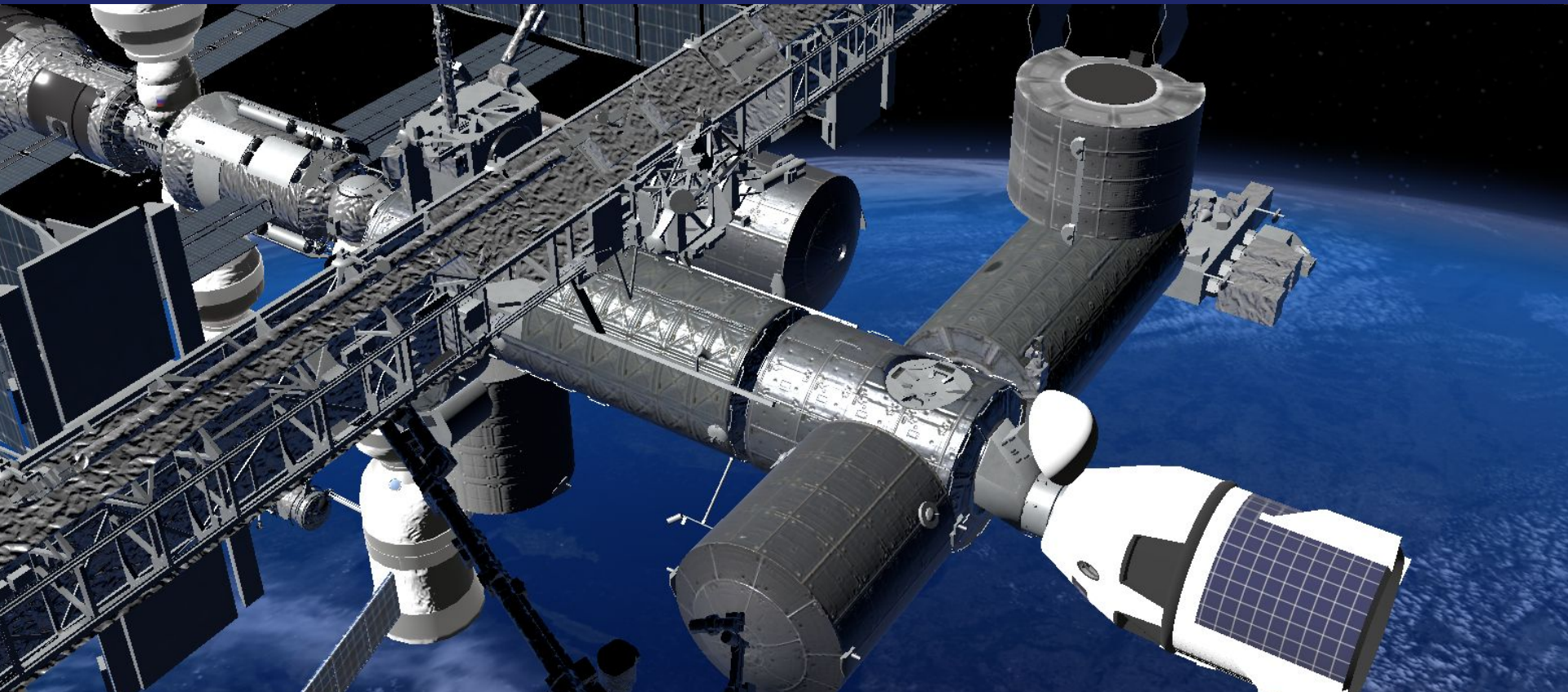
Latest training on PaleBlue system:
November 2023

ZERO G SIMULATION
SOFTWARE ASPECTS

MODELING

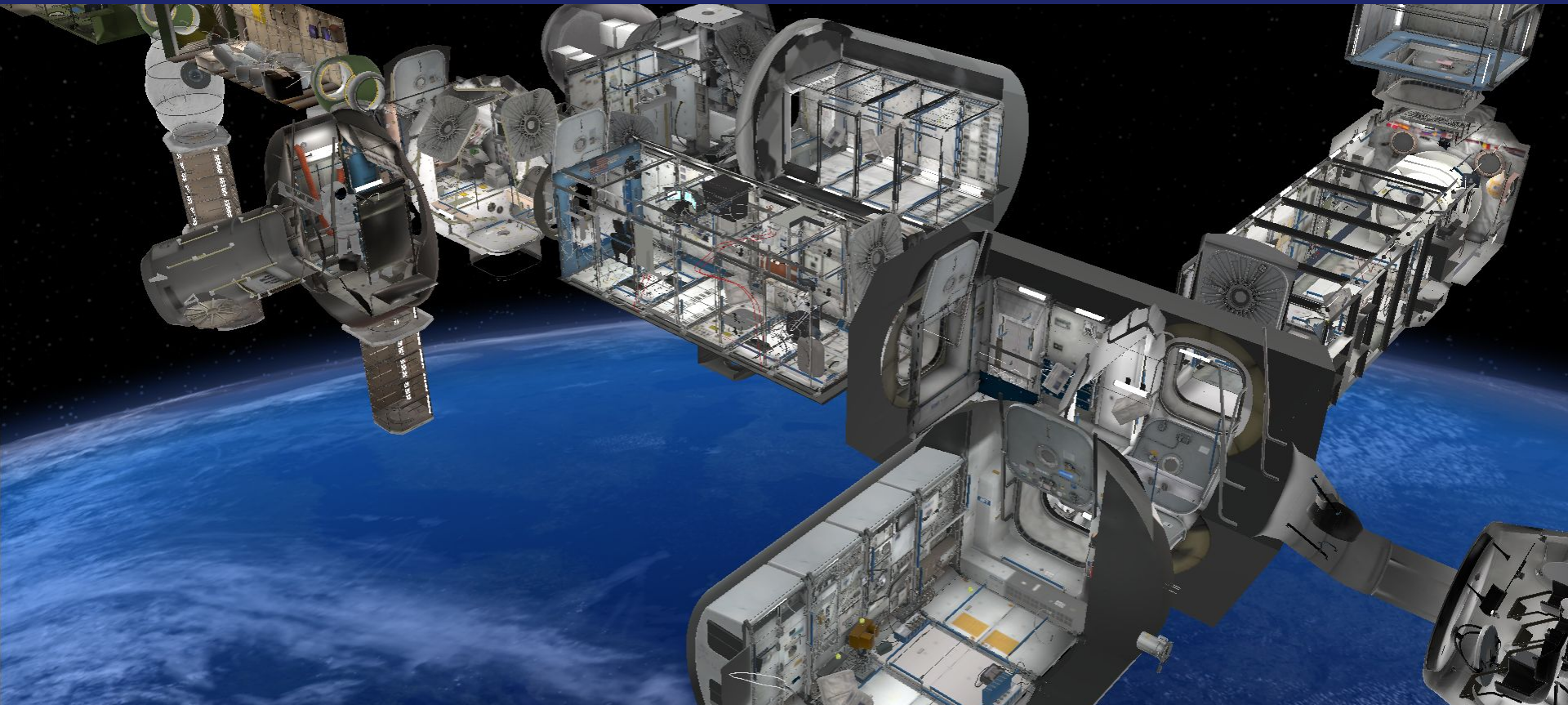
ISS EXTERIOR

ISS Exterior 3D model in PaleBlue VR training simulator.



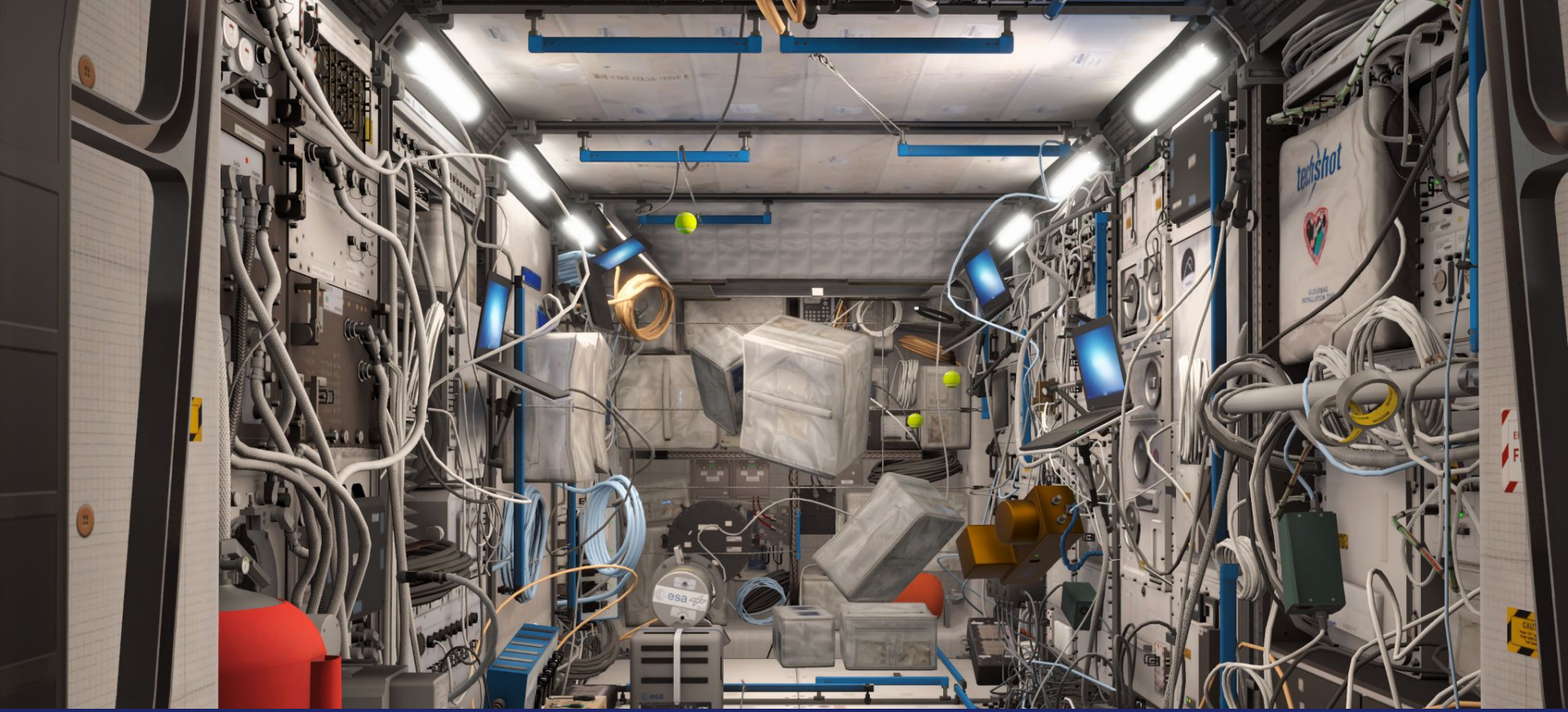
ISS INTERIOR

ISS Interior 3D model in PaleBlue VR training simulator.



SPACEX DRAGON

SpaceX Dragon 3D model, exterior and interior, in PaleBlue VR training simulator.



LIGHTING IN 3D ISS MODEL

A combination of static and dynamic lighting for real-time simulation.

DAY AND NIGHT MODE

Real-time switching of ISS lighting in the PaleBlue simulator

LOCOMOTION

LOCOMOTION

Zero G modeling engine to enable true navigation around the station in VR mode.

PARABOLIC FLIGHT CAMPAIGN

A Parabolic Flight Campaign carried out in November 2022.

PARABOLIC FLIGHT CAMPAIGN

In the Parabolic Flight Campaign, motion capture on Zero G movements was performed, in order to calibrate virtual Zero G model.

SIMULATION FEATURES

MULTIPLAYER

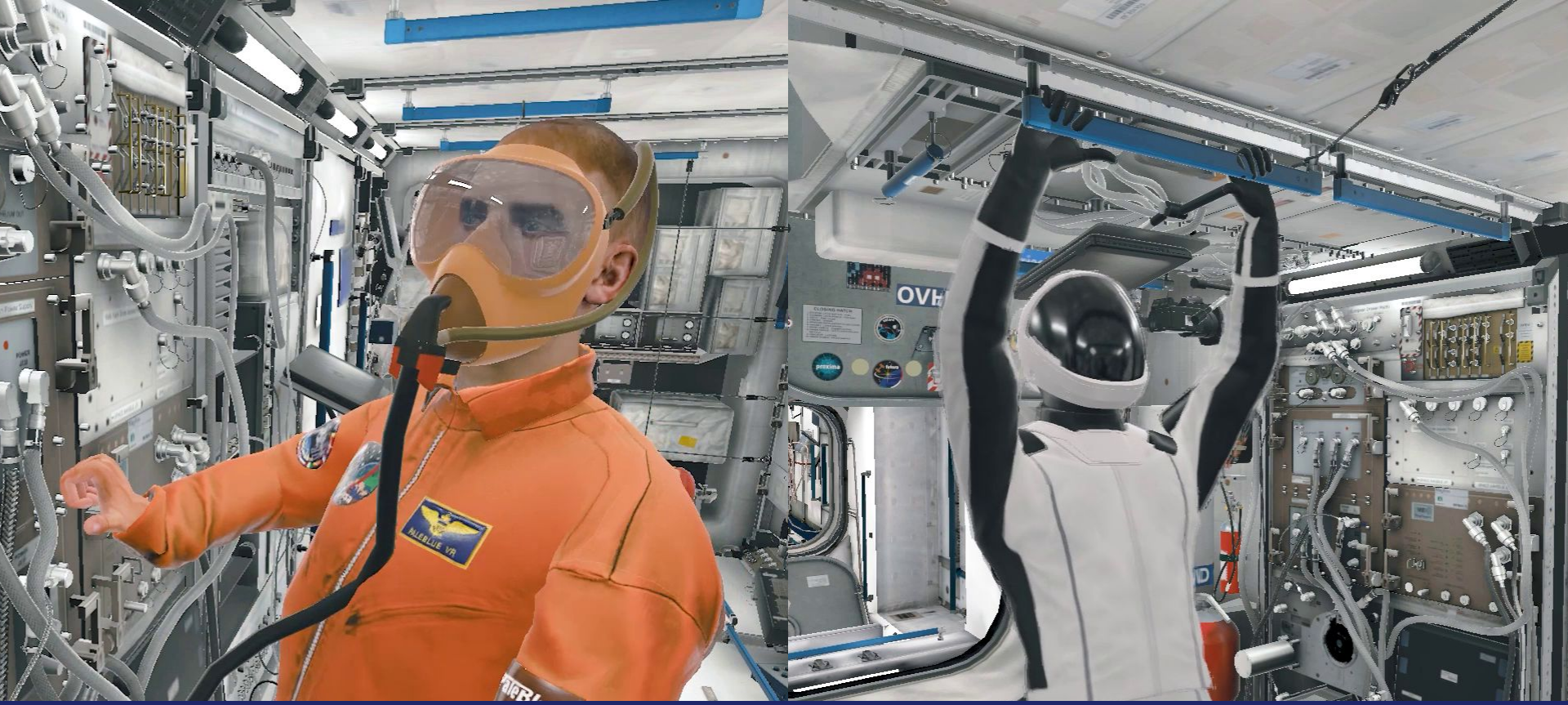
Up to 15 simultaneous VR users supported in real-time VR multiplayer scene.

EML HANDLING

Sample Chamber installation procedure in the Columbus ISS module, implemented in VR.

RACK TILTING

Rack tilting implemented in the virtual ISS model, including locking/unlocking mechanism.

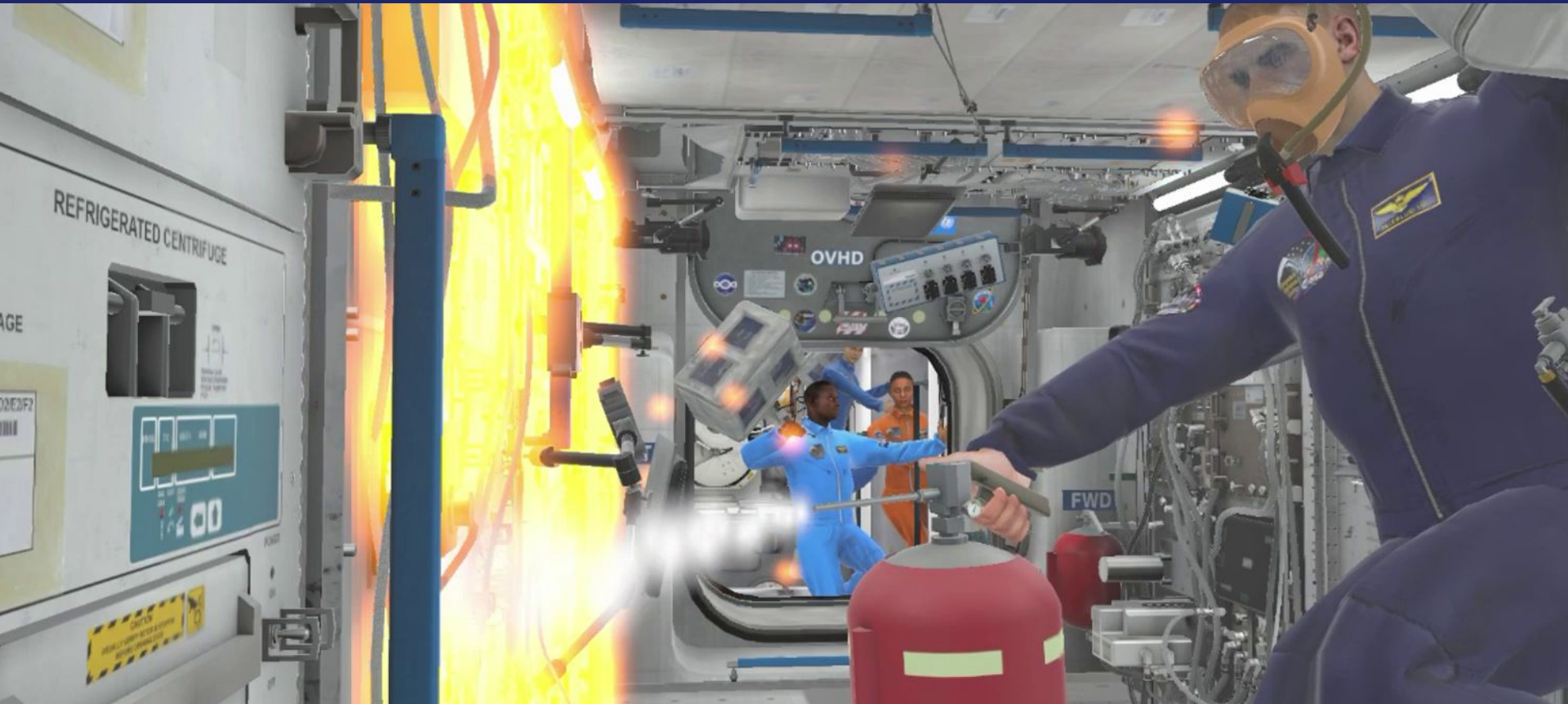


SUITS AND MASKS

The simulator supports putting on suits (SpaceX Dragon, EVA / EMU), as well ask masks (gas masks).

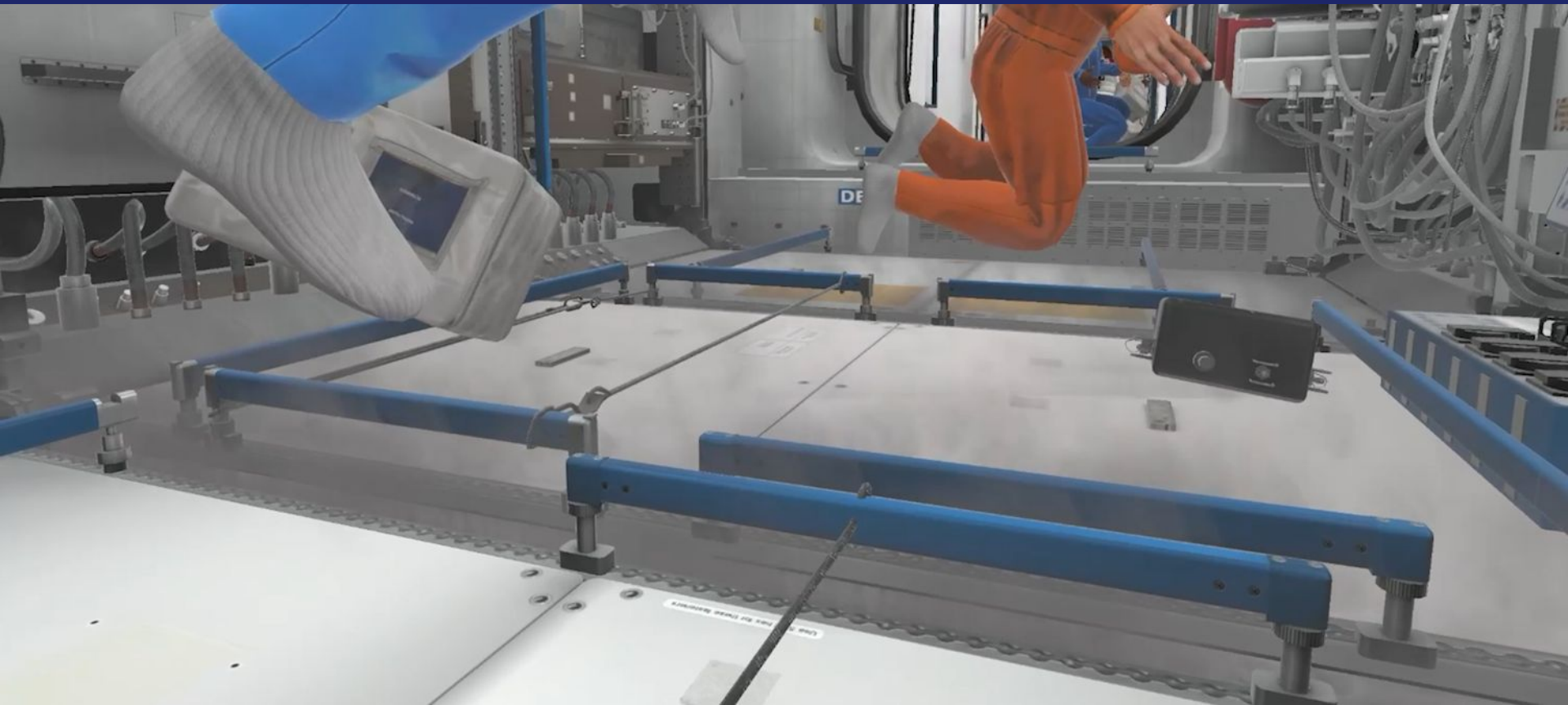
FIRE EXTINGUISHING

Instructor can trigger smoke and fires, while trainees have to locate fire extinguishing equipment and put fires out.



SMOKE SIMULATION

Instructor can initiate smoke in (under) designated station racks.



LOCK OUT & LOCK IN

Support of lock out and lock in within the same simulation, so that VR users can be simultaneously inside and outside the ISS.

ZERO G SIMULATION
HARDWARE ASPECTS

VR HEADSET

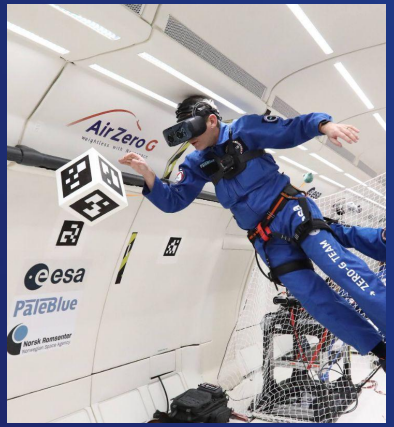
Meta Quest 3 supported for standalone experiences, while Varjo XR-3/XR-4 is used for PC-based high fidelity experience.

BODY POSITIONING

TRAINING MODES

STATIONARY

FREE-ROAMING



PARABOLIC FLIGHT

MOTION PLATFORM

Various training modes have been identified, while stationary being the primary one.

HIGH STOOL

ZERO G CHAIR

GYM BENCH

Various body positioning hardware has been tested in order to find the optimal and natural placement for Zero G comfort and freedom of movement.

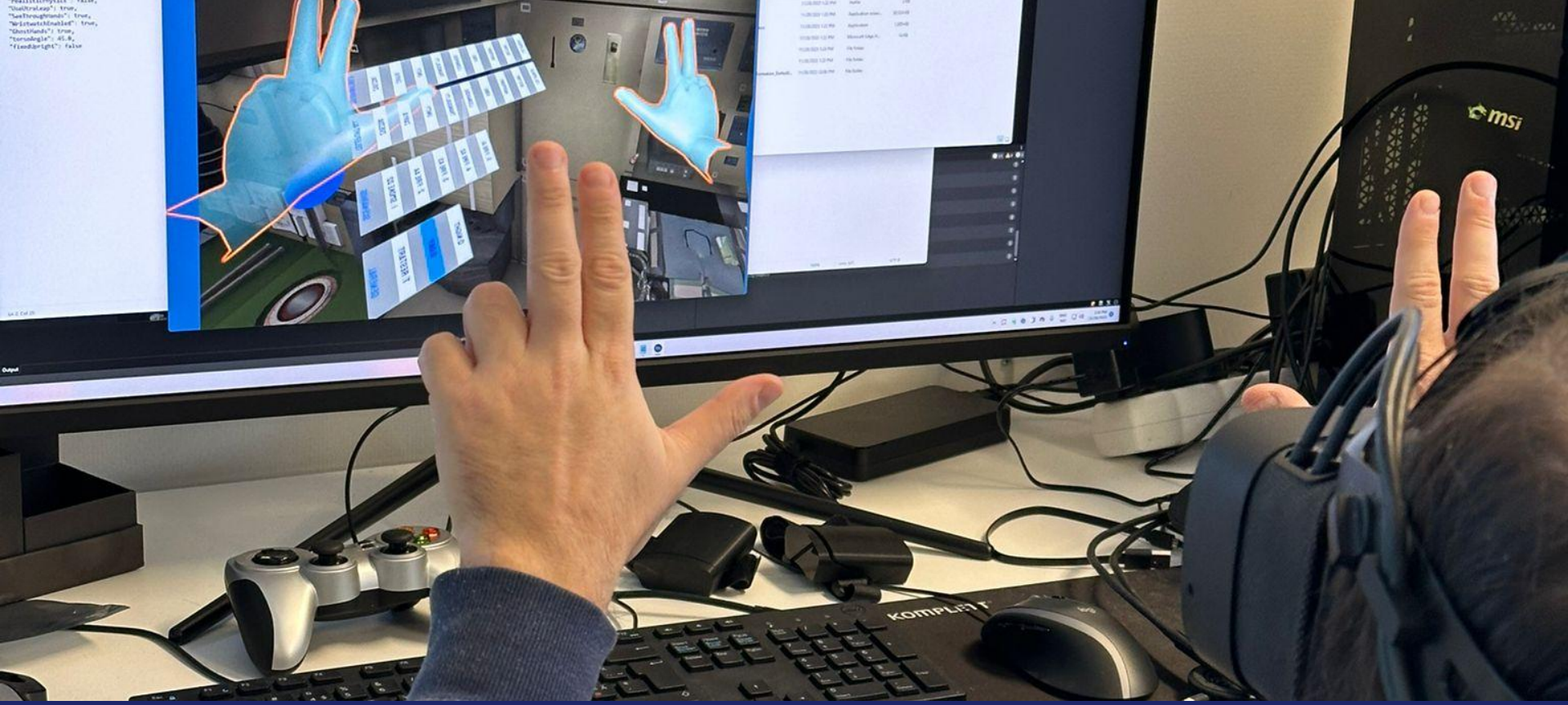
BODY POSITIONING

Body positioning experiments using high bar stool and Zero Gravity chair (beach/garden recline chair).

CONTROLS & FEEDBACK

VR HAND CONTROLLERS

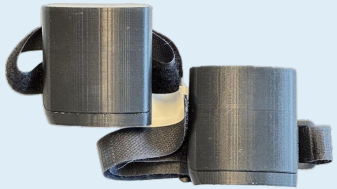
Hand controllers identified as the option giving most predictable tracking and finger operation.



HAND & FINGER TRACKING

The most natural way of controlling virtual hands in Zero G, though tracking area is limited when operating behind the back.

HAPTIC DEVICES



Custom haptic devices have been built by ESA EAC and tested with the simulator. The haptic devices can be strapped to arms, shoulders, knees and feet to provide vibrational haptic feedback when respective body parts come in contact with the structure.

ZERO G SIMULATION
USE CASES

USE CASES

The following use cases have been identified:

- **Spacecraft Familiarization**
  The simulation has been used to familiarize users (astronauts and astronaut reserve) with the layout of the ISS. Support of the Lunar Gateway is underway.
- **Zero G Locomotion**
  The created simulated Zero G is used to teach users navigation and locomotion in Zero Gravity conditions.
- **Sickness Alleviation**
  Exposure to the tool aids alleviation of the Zero Gravity sickness, the longer the expose, the lesser the sickness.
- **Human-Centric Design**
  The tool can be used for verifying human-centric aspects while designing spacecrafts.

PaleBlue VR Zero G Simulation:
Vogue Project Demonstration

CLICKABLE VIDEO

PaleBlue

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