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MIXED REALITY FOR PILOT TRAINING

VR TECHNOLOGY FOR SIMULATION

Principles and advantages

Smaller and more affordable systems

Full virtual environment: visual scene & cockpit

Full immersion : 360° Field of View

Pilot avatar simulation for head/hands/legs animation

Real buttons for cockpit interaction for haptic feedbacks

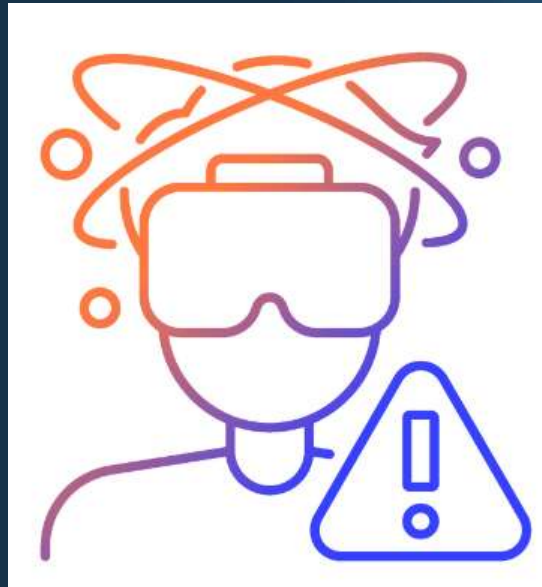**Good simulation fidelity thanks to OEM data**

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VR TECHNOLOGY FOR SIMULATION

Current and general limitations of VR pilot training solutions

Generally single pilot

No solution yet for MCC

Not really adapted to complex glass cockpit helicopters

Concern for people who wear glasses

Not adapted to long training sessions

Risk of motion sickness and fatigue

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VR TECHNOLOGY FOR SIMULATION

Other limitations to consider

Vergence Accommodation Conflict (VAC)

Headset display freezes the focusing range at a fixed distance for all objects, instead of having a variable focusing range according to the position of the observed object

Vestibulo Ocular Reflex (VOR)

Reflex allowing the eyes to keep locked onto a fixed object while the head is moving, producing eye movements in a counter direction
This physiological reflex is one of the fastest known for human that not all current headset can reproduce, forcing additional head/eyes movements to compensate

Source of fatigue and VR motion sickness

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MIXED REALITY FOR FLIGHT TRAINING

Merge of virtual images and real images

Virtual image

Real image

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2 SOLUTIONS FOR MIXED REALITY

Using cameras or See-Through headsets

Real image is captured by cameras
A cockpit mask defines the area to capture with cameras
Both virtual and captured images are merged and displayed together

Real image is directly seen through the headset
A cockpit mask defines the area where virtual image doesn't need to be displayed

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MIXED REALITY FOR FLIGHT TRAINING
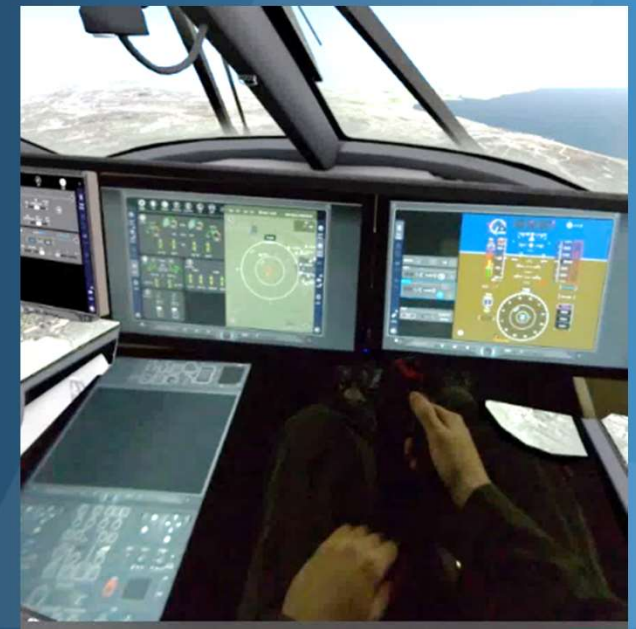
Merge of virtual images and real images

Solution with cameras

Virtual image

Real image captured
with cameras

See through solution

Virtual image

Direct view

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MIXED REALITY WITH CAMERAS

Headset view

Real touchscreens and hands are visible in the virtual cockpit and environment

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MIXED REALITY SOLUTIONS COMPARISON

Advantages and disadvantages of each solution

Solution with Cameras

- Good perception of the global image
- Can easily see pilot hands & legs and interact with the cockpit
- Can manipulate real instruments and touchscreens captured by cameras

- Limited resolution of cameras
- Hands are not visible if not in the area captured by cameras

See-Through solution

- Pilot hands & legs are seen in real and cockpit interaction with instruments can be performed directly
- No latency on hands motion
- No resolution limitation : direct view
- Hands are always visible if sufficiently lighted

- Requires a good balance of lighting between real image and virtual image
- Limited vertical FoV on tested headset

- Possible « Floating » effect between virtual and real images (but can be fixed)
- Importance of the headset calibration and distortion : requires a perfect alignment between virtual and real views

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MIXED REALITY SOLUTIONS COMPARISON

Training capabilities

Solution with Cameras

- Good for piloting : large Field Of View
- Can perform procedure training thanks to the interaction with the instruments when replicated
- Well adapted to specific mission training such as sling/hoist operations
- Can read paper map, a tablet

- Current limitation on camera resolution, may be an issue to read some instruments
- Cockpit interaction limited when hands are visible (in the area captured by cameras)

See-Through solution

- Good for piloting : large horizontal Field Of View
- Can perform procedure training thanks to the direct interaction with the instruments when replicated
- Can read paper map, a tablet
- Hands can always be visible if sufficiently lighted

- Limited vertical Field Of View requires to move head for specific missions such as sling/hoist operations

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MIXED REALITY FOR MCC

Solutions exist for MCC

Solution with Cameras

- « Chroma key » technology is needed in addition to cameras to see the other pilot in the virtual environment
- The other pilot is seen as in the real world

See-Through solution

- It's possible to directly see the other pilot assuming he/she is sufficiently lighted
- No other objects must be visible behind or close to the other pilot

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CONCLUSION : MIXED REALITY BENEFITS

MR is an important complement to VR solutions

Glass cockpit ✔

Complex avionic ✔

Touchscreens ✔

Real equipment ✔

✔ Flight & procedure training

✔ IR Instrument training

✔ Type rating

✔ MCC training

But what about Proficiency Checks ?

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THANK YOU FOR YOUR ATTENTION

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