

HUMAER: A Testbed Environment for Human Factors Investigations in the Aeronautic Domain



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AEROSPACE TECHNOLOGY CONGRESS 2019
SUSTAINABLE AEROSPACE INNOVATION IN A GLOBALISED WORLD

FT2019

October, 2019

Where I come from

- The city of São José dos Campos in Brazil



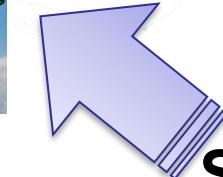
São José dos Campos - the Brazilian Aerospace Cluster



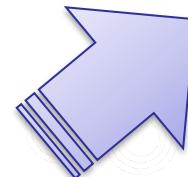
Brazilian aircraft manufacturer



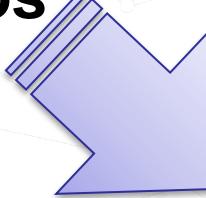
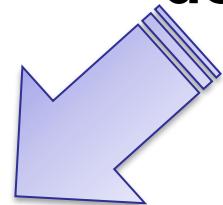
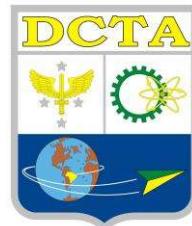
Space and Aeronautics Institute



**São
José
dos
Campos**



National Institute for Space Research



Aeronautics Institute of Technology (ITA)

Presentation Overview

1. Introduction

2. HUMAER: Human Factors in Aeronautics Laboratory

3. Research Topics & Interests

4. Research Samples: why SIVOR?

5. Prospective Projects

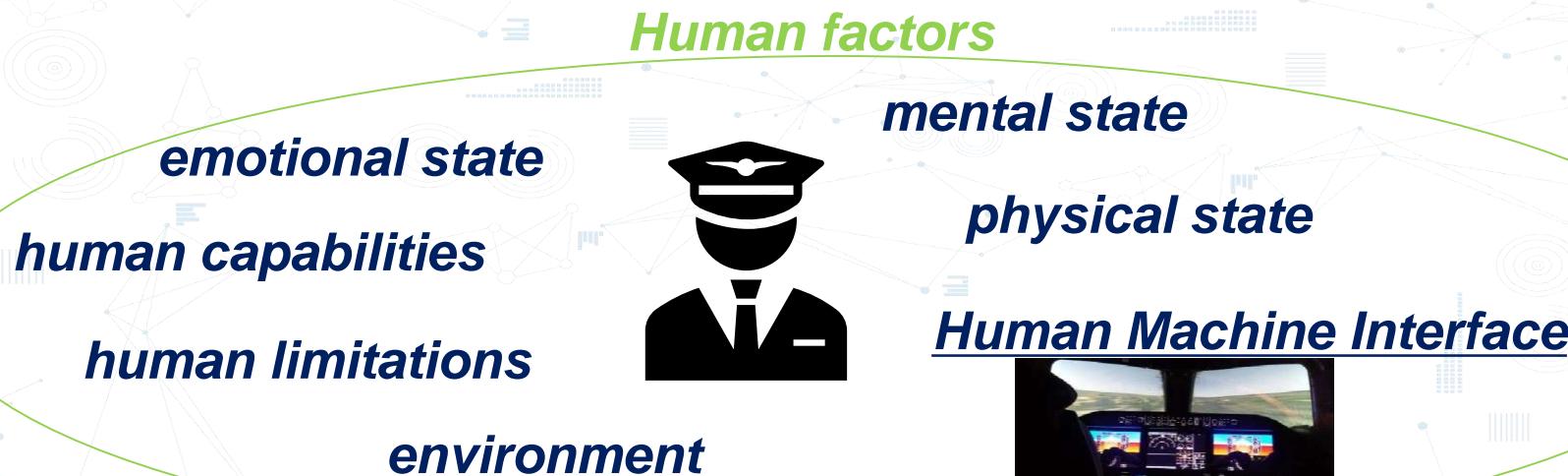


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Arjoni, D. H.; Oliveira, W. R.; Trabasso, L. G.; Villani, E. HUMAER: A Testbed Environment for Human Factors Investigations in the Aeronautic Domain.

Why Human Factors?

- “Human error has been documented as a primary contributor to more than 70 percent of commercial airplane hull-loss accidents ...” (Boeing – Ref1*)



*Ref1: BOEING. Available online at: http://www.boeing.com/commercial/aeromagazine/aero_08/human_textonly.html



SIVOR – Flight Simulator with a Robotic Platform



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SIVOR & Human Factors

How do we **evaluate** the motion system of SIVOR?

How do we **perceive** and **react** to motion?



Vision
system



Somatosensory
system



Vestibular
system

Influence of a
number of other
parameters and
variables:

PSYCHOLOGICAL
STATE

PREVIOUS
HISTORY

WORKLOAD

HEALTH

ETC.

HUMAER: Human Factors in Aeronautics

Prof. PhD Luis Gonzaga Trabasso



DESIGN AND COMMISSION OF A HUMAN FACTORS LABORATORY FOR AERONAUTICS

DESIGN FOR SITUATED COGNITION FRAMEWORK APPLIED TO AERONAUTICAL DOMAIN

EXPERIMENTAL APPROACH



Neuro physiological sensors: EEG, respiration, heart rate, eye trackers, ...



Performance measurements



Subjective ratings



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GOAL – HUMAER: Human Factors in Aeronautics

- Introduce the **Human Factors in Aeronautics Laboratory (HUMAER)** from ITA, evincing its research capabilities and interests.



EEG

Eye-tracker

TCE and ECG

GSR & EMG



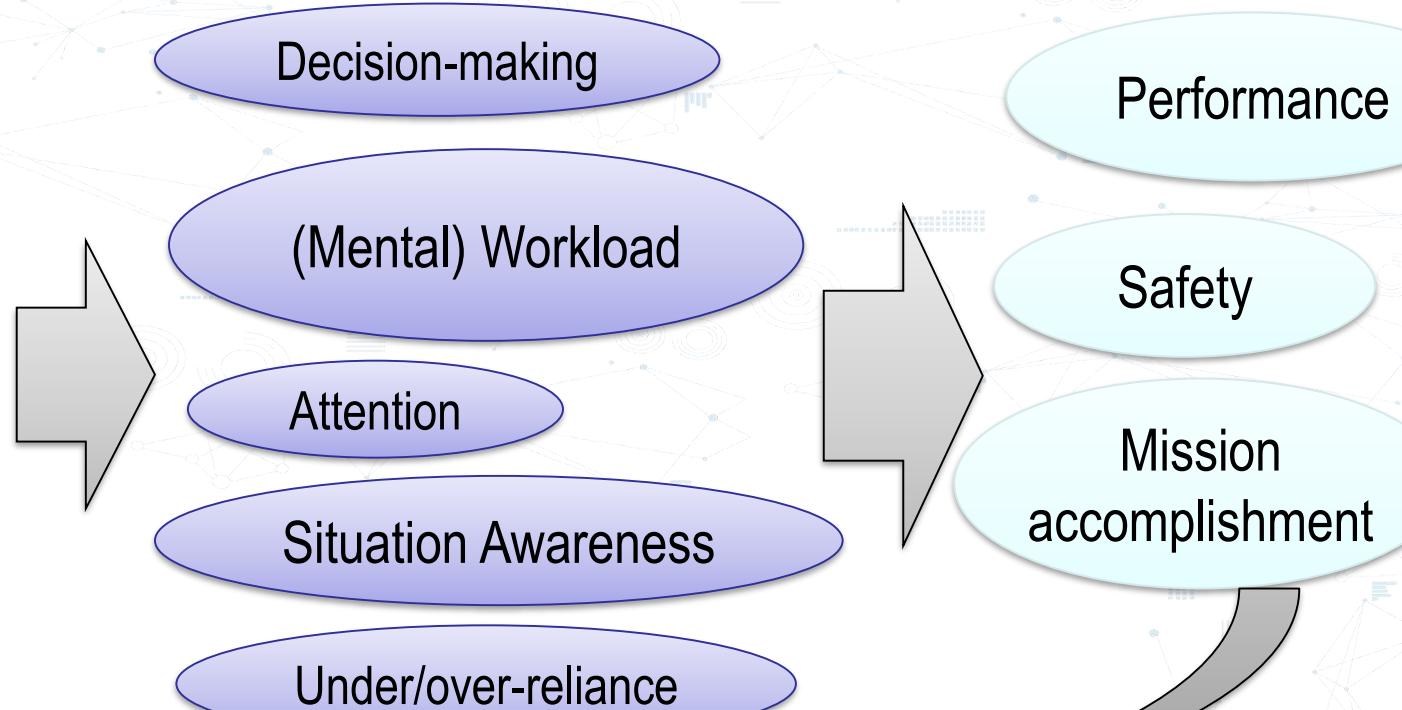
HUMAER at



HUMAER: Human Factors in Aeronautics

**SYSTEM
DESIGN**

**HMI
DESIGN**



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HUMAER: Human Factors in Aeronautics

And we open Pandora's box...

Does the motion systems add significant value?

Can we use SIVOR for training upset recovery manoeuvres?

Single-pilot cockpit?

Can we use neurophysiological sensors to understand human machine interface?

Etc, etc, etc.

Does it induce negative training?

How do different failures affect the pilot?

What is the best level of automation in a cockpit?

Is situational awareness affected by the motion system?

Does the rail add significant value? When?

Can we propose more intuitive interfaces?



Pilot HMI Effectiveness – Stressful Conditions



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Aircraft control interface in the last 100 years...

Breguet 14



Northrop B-2 (1989)



https://cs.wikipedia.org/wiki/Breguet_14

<https://www.airliners.net/photo/Thailand-Air-Force/Breguet-14-B2/4930371>

https://aeromagazine.uol.com.br/artigo/o-aviao-mais-caro-da-historia_2013.html

<https://www.boldmethod.com/blog/lists/2015/08/21-facts-about-the-b-2-spirit-stealth-bomber/>



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Intuitive pilot-aircraft interface

Can we design more **intuitive** pilot aircraft interfaces?



- Pitch, yaw, roll and thrust control based on gesture

Case 1 - Aircraft control based on body motion



Intuitive pilot-aircraft interface

Case 1 - Aircraft control based on body motion

- Use of virtual reality kit to monitor body motion



HTC Vive virtual reality kit



Intuitive pilot-aircraft interface

Case 2 – Aircraft landing guided by eye gaze

- Adjust heading based on eye gaze direction or by pointing at it



Hand-pointing
vector

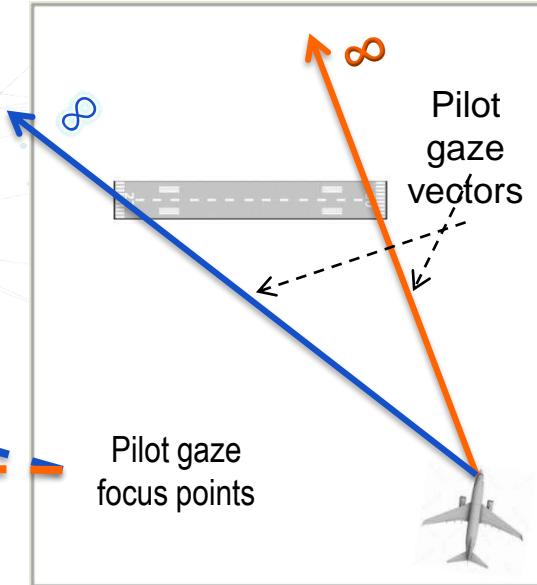
Gaze vector

Intended flight
heading



Intuitive pilot-aircraft interface

Case 2 – Aircraft landing guided by eye gaze



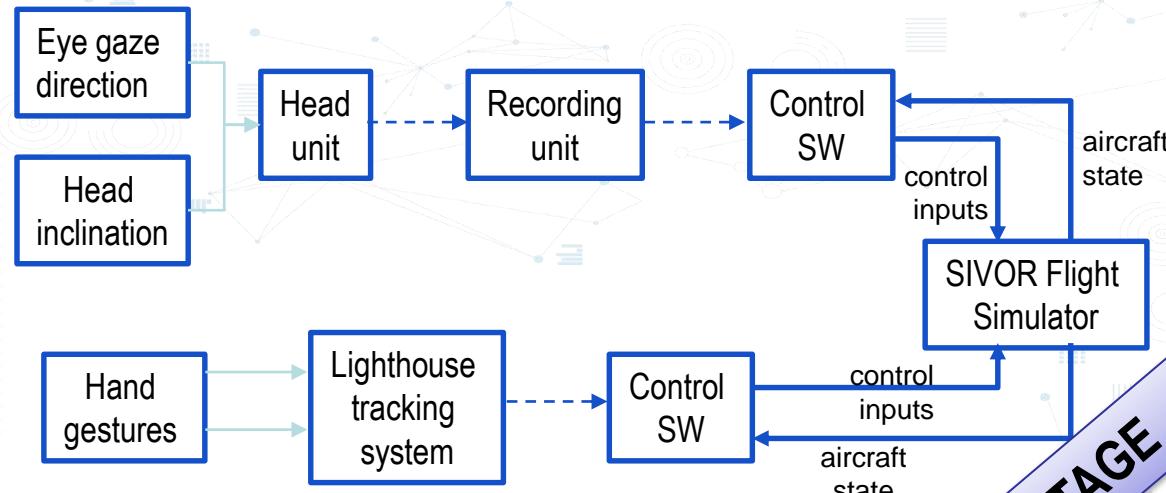
Intuitive pilot-aircraft interface

Case 2 – Aircraft landing guided by eye gaze

- Use of eye tracking



Prototype Implementation and Evaluation in SIVOR Flight Simulator



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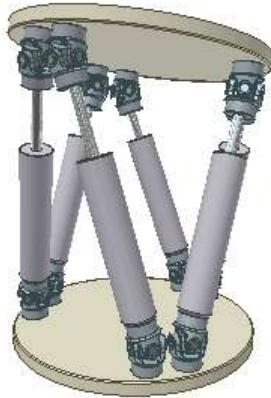
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Research Samples: why SIVOR?

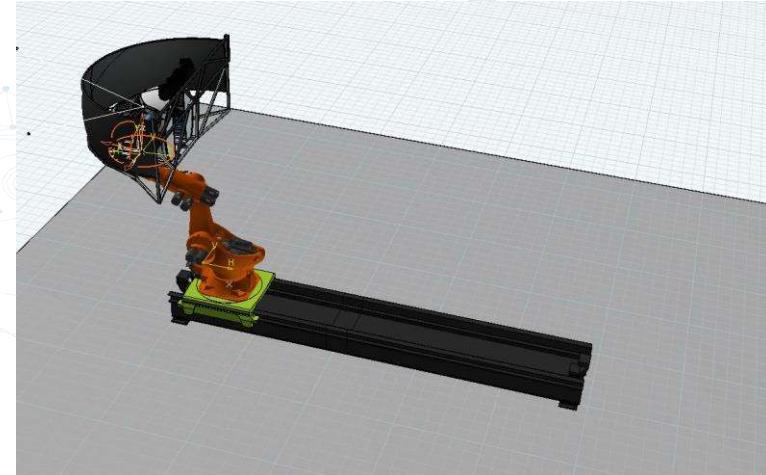
Hexapod Configuration

Stewart Platform



- Parallel configuration
- 6 linear actuators
- Hydraulic or electrical

SIVOR



- Rail: 7 m
- Plus 6 d.o.f.: greater workspace
- High Gain Manuevers

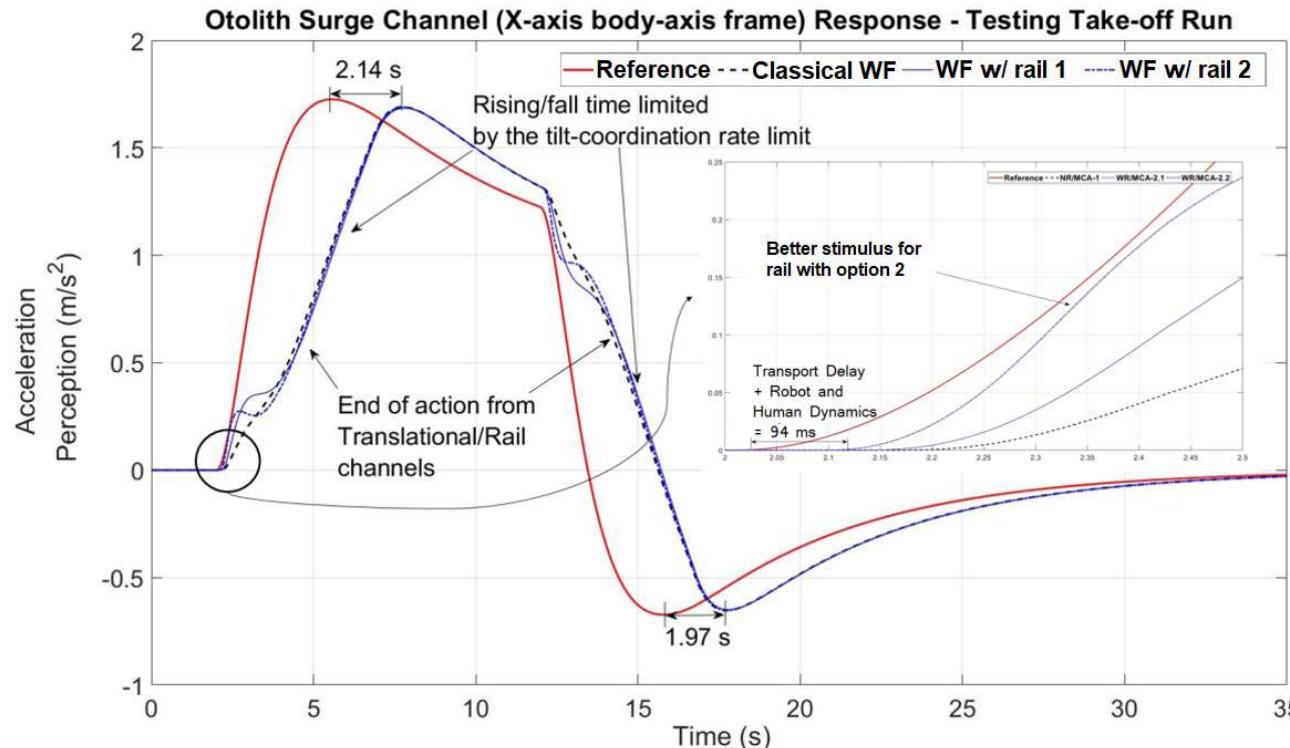


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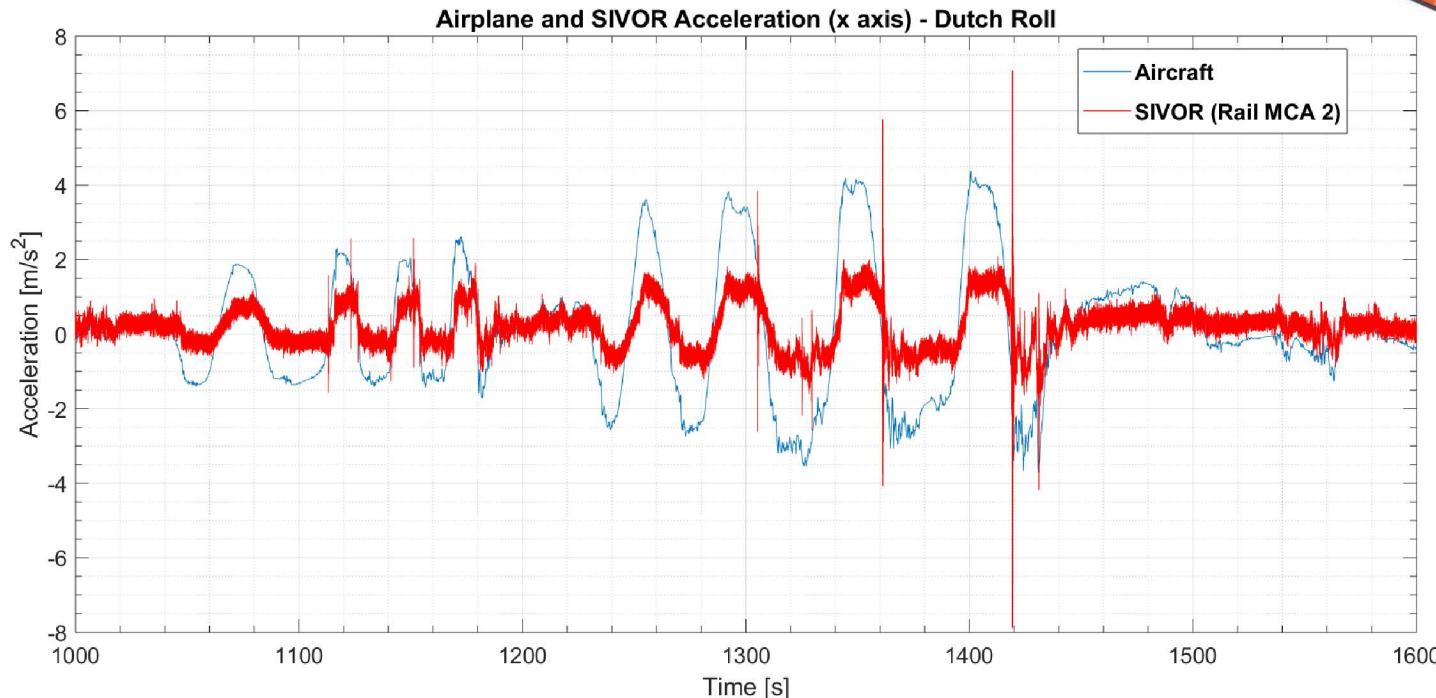
Research Samples: why SIVOR?

What about pilot sensations (model-based)?



Research Samples: why SIVOR?

What about pilot sensations (experimental - measured)?



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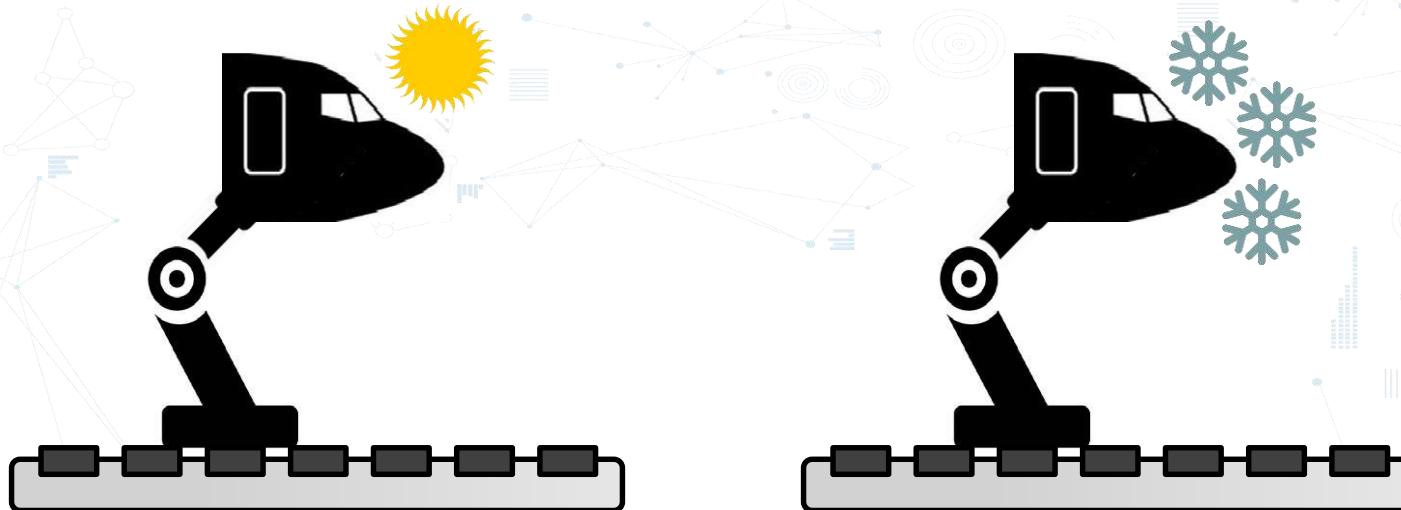


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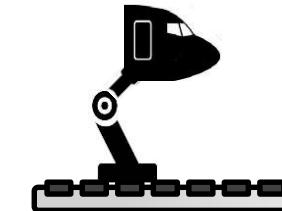
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HUMAER Initiatives

What is the effect of
thermal stress on the pilot
cognitive behaviour?



Performance Assessment of Air Traffic Controllers



Can augmented/mixed reality improve situational awareness?



Survey
with pilots

Selection
of case
studies

Prototypin
g

Evaluation

Can augmented/mixed reality improve situational awareness?



- Selection of landing area in case of failure

Ideas from the
pilots' survey

Can augmented/mixed reality improve situational awareness?



- Visualization aid when landing by instruments
- Iconic intuitive representation when flying by instruments



Ideas from the
pilots' survey

Thank you!!



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