MAY VIRTUAL TOWERS BECOME REALITY?!

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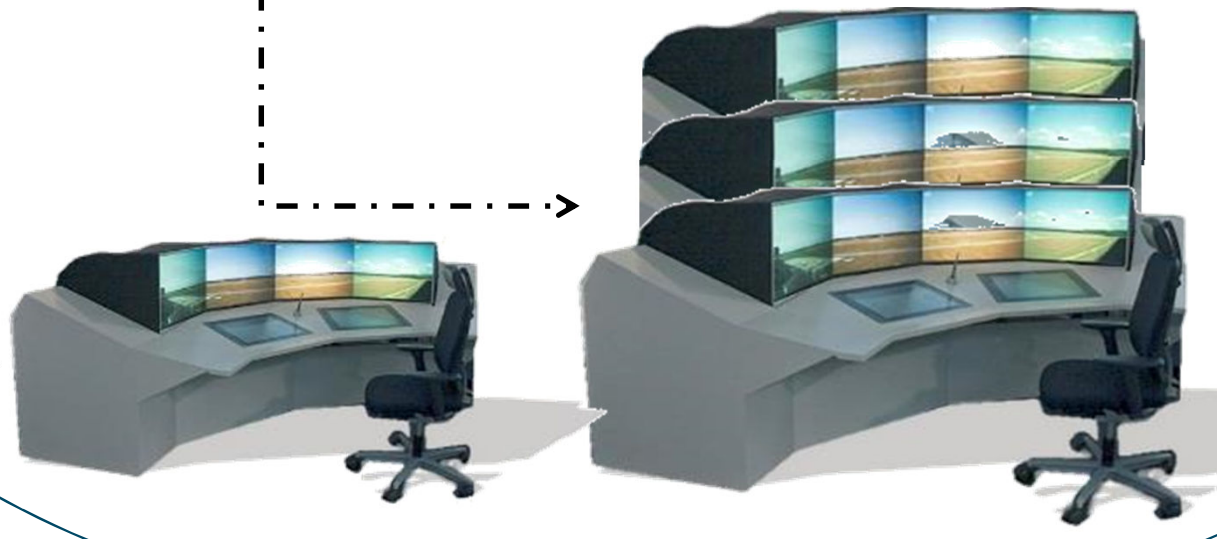
DLR

What is Remote Tower?

Multiple Remote Tower Center



But for what for?

➔<u>Opportunity to increase</u>:

- ➔Cost-effectiveness
- ➔Service Level
- ➔Safety
- ➔Job Satisfacion

Airports in Germany

- 15 International
- 20 Regional

+ 370 smaller ones

Quelle: Wikipedia: Liste der Verkehrsflughäfen in Deutschland

State of the art Remote Tower Optical Systems (RTOS)

Copyright: DFS

Copyright: FREQUENTIS

Conventional Remote Tower (>500K€ investment)

Remote Tower Controller Working Position at RTC Leipzig
Source: DFS GmbH

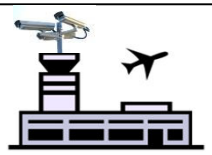
How can we make it even cheaper?

<u>Smallest Airports:</u>

- Lower Service Level (no ATC but AFIS/RADIO)
- Less traffic, less commercial air traffic, less IFR operation
- Less complex and time critical

➲ Less sophisticated remote tower setups may be sufficient possibly

Basic Building Blocks of a Remote Tower Optical System (RTOS)



Aerodrome location

Operator at RTM remote location

Optical Sensors

Image Encoder / Processing

Network

Image Decoder / Processing

[*Augmented*] Optical Sensor Presentation

PTZ Function

Control HMI

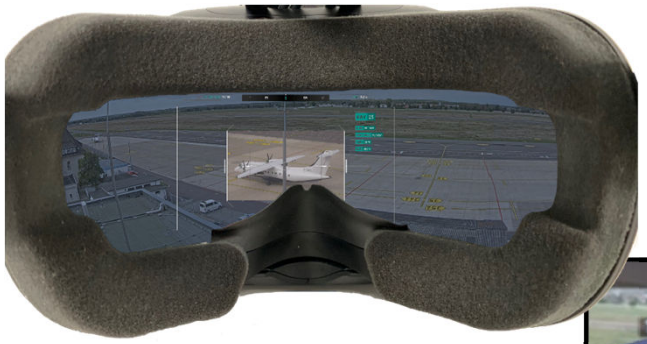
System Border

Time Source

Source: EUROCAE ED-240B (2023)

Example Configurations for RTOS(s)

Optical Sensors	Horizontal x Vertical	Pixel per degree & (Total MP)	Average bits/pixel ratio (12 = standard)	Frames per second (fps)	H.264 1:125 (standard)	Erforderliche Bandbreite
Rotating Camera Sensor	360° x 60°	60 (~78 MP)	~12	5	~1:125	~37 Mbit/s
Fixed Full HD ~14x HD Cameras (portrait)	360° x 45° 25° x 45° per cam	43 (~30 MP)	~12	30	~1:125	~86 Mbit/s
Fixed 4K ~11x 4K Cameras (portrait)	360° x 60° 34° x 60° per cam	64 (~88 MP)	~12	30	~1:125	~255 Mbit/s
PTZ Camera HD 30x zoom	64° x 36° (wide) 2,2° x 1,2° (tele)	30 (~2 MP) 873 (~2 MP)	~12	30	~1:125	~6 Mbit/s
Low Budget Pano 2x HD Cameras (landscape)	360° x 90° 180° x 90° per cam	22 (~14 MP)	~12	15	~1:600	~5 Mbit/s

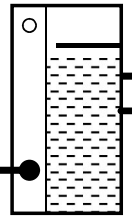


PTZ-Camera
5.000 €

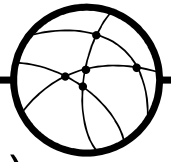
2x Panorama-Camera (= 360°)
3.200 €

VR-headset
600 €

Computer
ca. 2.000 €

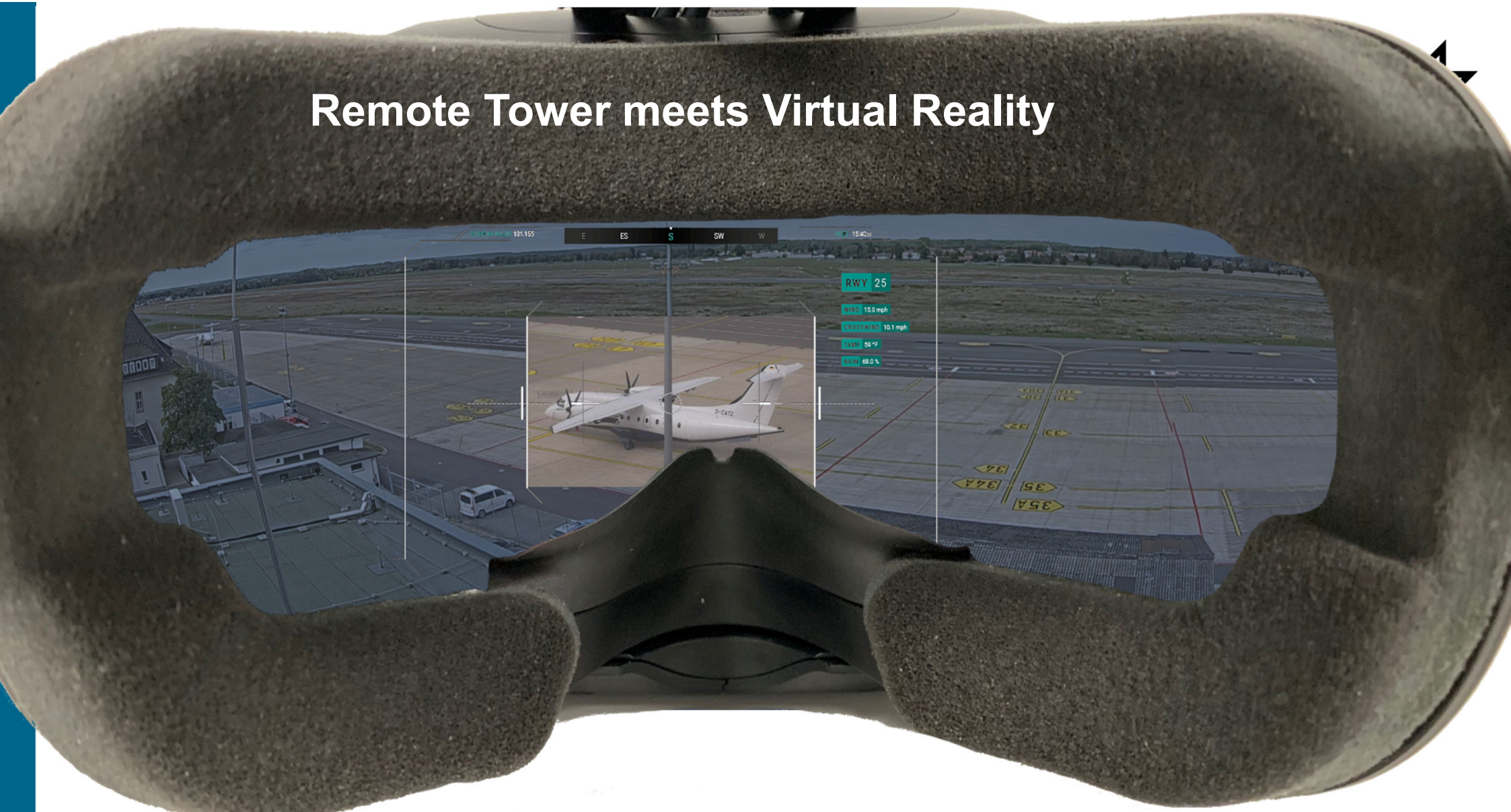


bandwidth
ca. 11 Mbit/s
(3G+ possible)



Total costs: ca. 12.000 €
+ network costs
+ camera set-up
+ others

Remote Tower meets Virtual Reality



PTZ View from EDVE to Brocken (55km away)


EDVE
07:17:36
Flugerfassung
Abgeschlossen
Flugpläne
Kennzeichen Typ Abflug Ziel Art Startzeit Landezeit Zusätzliches
Geplant
PWF911 D328 EDDS EDVE I 08:28 09:58
D-ETLY EDVY EDVE V 09:07 09:50
D-EHJF EDAZ EDVE V 08:47 09:44
D-EZGG EDVE EDVE V 08:48 10:06
Aktiver Flugbetrieb
Runway
PWF30 D328 ETSI EDVE I 09:05 09:46
230 / 10 KT
200V260
MEAN2
-05/L01
VIS
TEMP
DP


105 120 SE 150 165 S 195 210 SW 240 255 W 285 300 NW 330 345 N 15 30 NE 60 75 E
E2 5 km
E1 8 km
S1 14 km
M 12 km
W2 5 km
W1 14 km
N2 4 km
N1 8 km
C 11 km
W
EDVE
07:19:10
130°
13.0 kn
1013
9987 m
1300 ft
RWY 26
Flugerfassung
Abgeschlossen
Flugpläne
Kennzeichen Typ Abflug Ziel Art Startzeit Landezeit Zusätzliches
Geplant
PWF911 D328 EDLS EDVE I 08:28 09:58
D-ETLY EDVY EDVE V 09:07 09:50
D-EHJF EDAZ EDVE V 08:47 09:44
D-EZGG EDVE EDVE V 08:48 10:06
Tx
Aktiver Flugbetrieb
Runway
Taxiing
DLR

Concept

- Complete Tower CWP in Virtual Reality
  incl. 360° Panorama + PTZ, interactive e-Flight Strips, Radio, VCS, Light Board, charts, MET, ambient sound
- Location independent (VR glasses wireless via WiFi / VPN and batterie)
- No hardware, except of VR glasses and cameras
- CWP updates and harmonization via software updates

= extremely flexible and cost-effective

= offering unlimited possibilities and freedom to create the exact work station YOU want and need. From anywhere at any time.

Prominent Use Cases

- ATC/AFIS on request
- Cooperation with other AFIS/RADIO airports (longer opening times)
- PPRs during airport closing hours
- Contingency, Training or Familarisation
- High resolution environment

Study at the DLR site in Braunschweig with 15 ATCOs & 7 AFISOs in shadow mode with life EDVE traffic

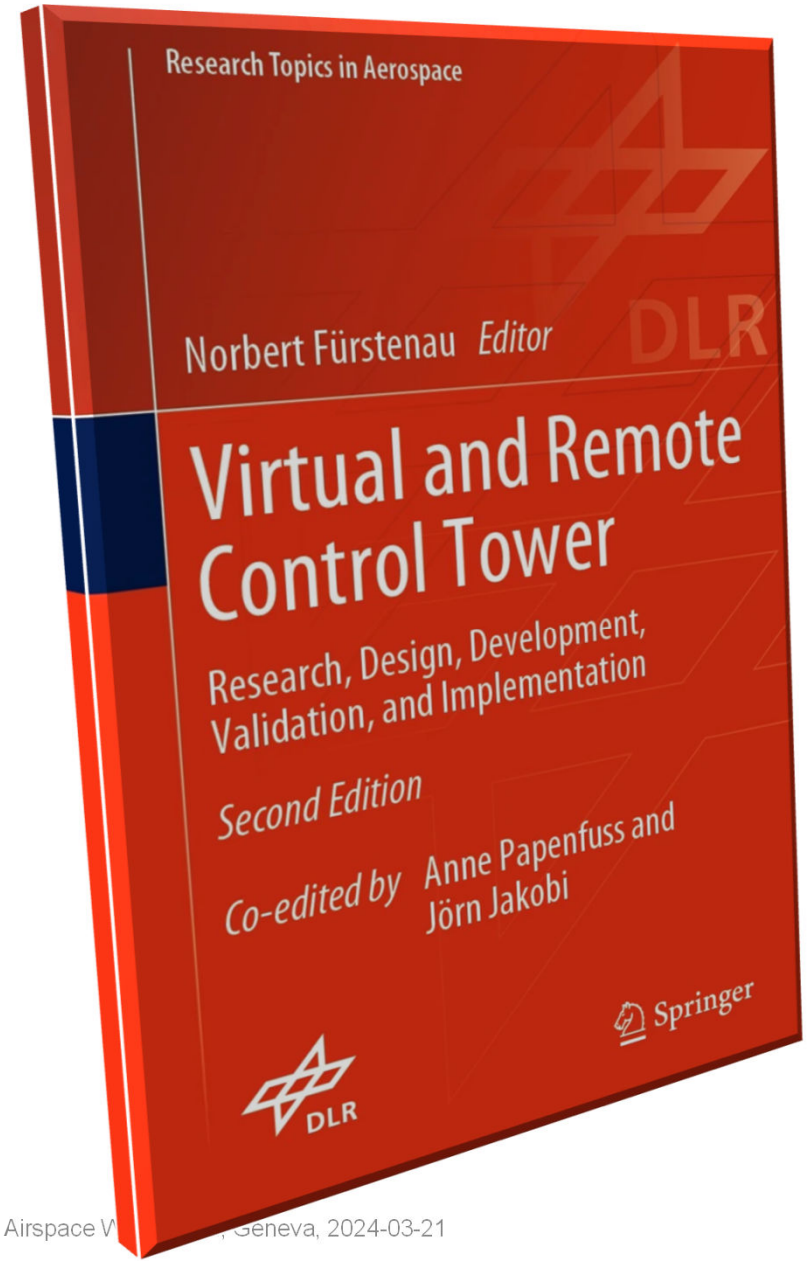
- Cyber sickness after 1h immersion within acceptable levels ✓
- Usability ✓
  - Very good results for UI
  - Okay results for PTZ camera movement

- ATCO/AFISO‘s found the freehand interactions with the panels very intuitive ✓
- Compared to a traditional RTS with monitors the Virtual Tower felt like being in a real tower ✓

Publications

Publication planned at EAAP35, Athens, Sep 2024

- Reuschling, Fabian und Jakobi, Jörn (2022) *Remote AFIS: Development and Validation of low-cost Remote Tower Concepts for uncontrolled Aerodromes.* CEAS Aeronautical Journal, Seiten 1067-1083. Springer. doi: 10.1007/s13272-022-00613-2. ISSN 1869-5590
- Opower, Helena und Jakobi, Jörn (2022) *Design Study for a Virtual Work Station for Aerodrome Air Traffic Service Officers.* In: 34th European Association for Aviation Psychology, EAAP 2022. The 34th EAAP Conference, 26.09.2022 - 30.09.2022, Gibraltar. doi: 10.1016/j.trpro.2022.12.012. ISSN 2352-1457
- Reuschling, Fabian und Jakobi, Jörn (2022) *Designing a low-cost Remote Tower Solution.* In: Virtual and Remote Tower (2nd edition) - Research, Design, Development, Validation and Implementation Research Topics in Aerospace. Springer Publishers. Seiten 543-566. doi: 10.1007/978-3-030-93650-1_22. ISBN 978-3-030-93649-5. ISSN 2194-8240
- Reuschling, Fabian und Jakobi, Jörn (2020) *Remote AFIS: Entwicklung und Validierung kostengünstiger Remote Tower-Konzepte für unkontrollierte Flugplätze.* DLRK 2020, 1.-3. September 2020, Online (ursprünglich Aachen, Deutschland)
- Hofmann, Thomas und Jakobi, Jörn und Biella, Marcus und Blessmann, Christian und Reuschling, Fabian und Kamender, Tom (2020) *Design and Implementation of a Virtual Workstation for a Remote AFISO.* In: 22nd International Conference on Human-Computer Interaction, HCII 2020, 12428. Springer International Publishing. HCI International 2020, Copenhagen, Virtual, 21.-25.7.2020, virtual. doi: 10.1007/978-3-030-59990-4_13. ISBN 978-303060113-3. ISSN 0302-9743
- Reuschling, Fabian und Blessmann, Christian und Jakobi, Jörn und Hofmann, Thomas (2020) *VR-Entwicklung und Validierung im Bereich Remote Tower.* Fraunhofer FKIE Symposium zu Virtual und Augmented Reality, 24. August 2020, Bonn, Deutschland



2nd Edition (2022)
„DLR Remote Tower Book“

https://www.remote-tower.eu/wp/

Remote Tower

Home

www.remote-tower.eu

The modernisation of air traffic management is one of the main challenges of current aeronautics research.The Single European Sky ATM Research (SESAR) project defines, develops and deploys what is needed to increase ATM performance and build Europe's intelligent air transport system.

Part of SESAR are the projects **PJ05 "Remote Tower for Multiple Airports"** and **PJ05-W2 "Digital Technologies for Tower"**, which focus on the safe and efficient airport of the future. By bringing the concept of remotely controlling multiple airports as well as HMI interaction modes for airport towers to higher maturity levels, the SESAR projects aim at providing small and medium sized airports with more cost-efficient and service tailored air traffic services.

The current programme is SESAR 2020 supports projects to deliver solutions in four key areas, namely airport

Recent News

SESAR PJ05-W2-35 Multi Remote Tower Online Open Day on 6 December

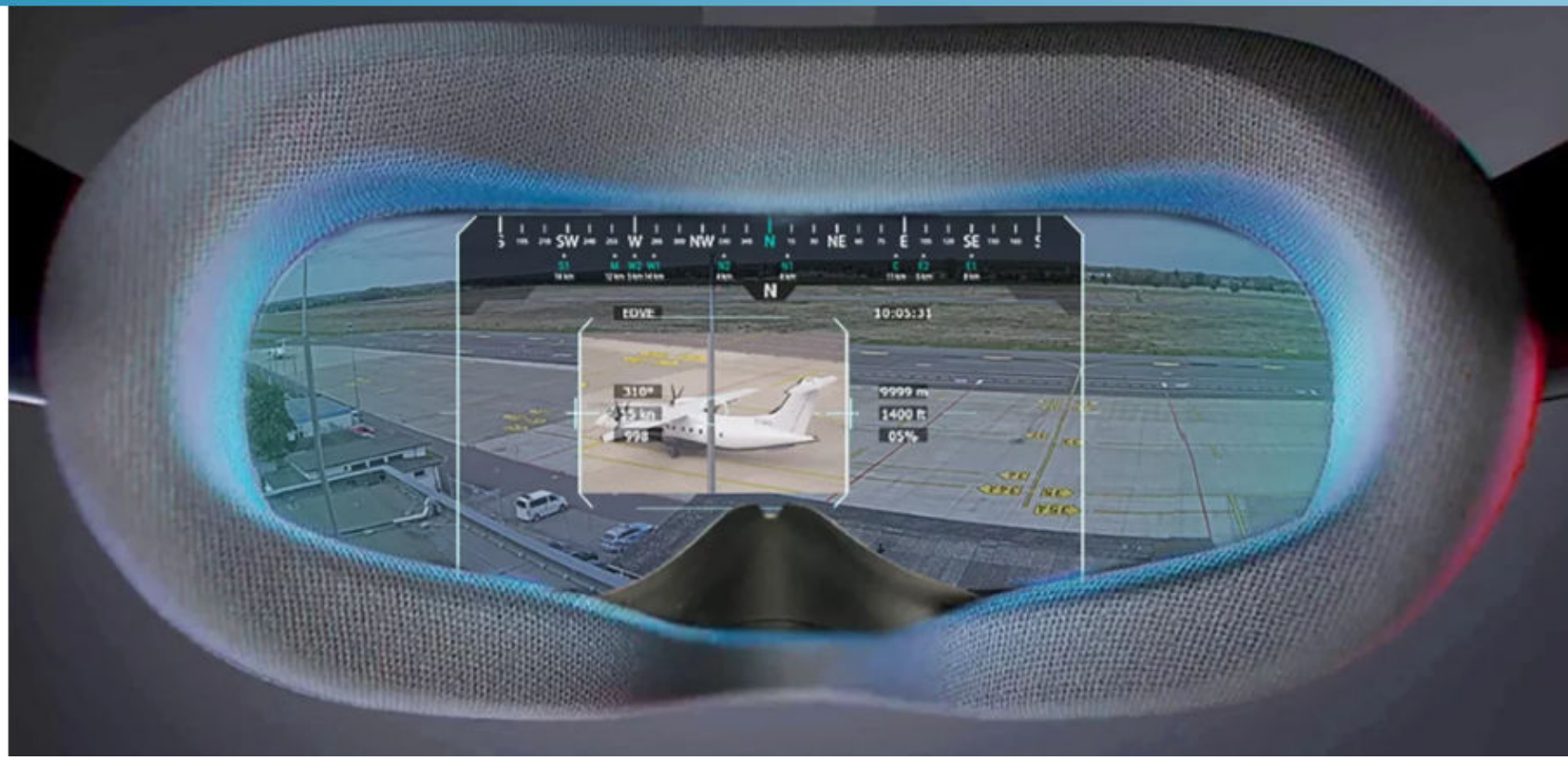
15. November 2021

EUROCAE WG-100

AT-One DLR nlr

ABOUT US NEWS PROJECTS EXPERTISE

Come and have a hands-on trial at our stand #D34



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Come and have a hands-on trial at our stand #D34

Check out the Video!

joern.jakobi@dlr.de

https://api.screen9.com/embed/suHtsfPWQP2P7TJ754HC7YpcN1JFj800ef7YTJo6sNlh70DP9wMfDyyr4c8Uj7UZ