The Vision

- Virtual Tower Control -

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What is the basic concept?
What is the core of this idea?

• **Cost Savings!**
  - Cost efficient allocation of personell by relatively small investment

• **Safety!**
  - Infrared Camera
  - Augmented Vision
  - Video Tracking

➤ **Sustainability of cost efficient air traffic control**
Where remote control can be a solution?

1. RTO Center for 1+n small or medium sized airports
2. RTO Center for 1+n big airports
3. Remote Control of view restricted Apron oder Runways
4. Contingency
How did DLR contribute to the development of remote Tower?

RApTOr 2005-2008
Important Results of our Research

- Operational and technical proof of feasibility:
  - Technical Requirements
  - Situational Awareness
  - Usability
  - Acceptance
  - Safety Risk Assessment
  - Workload
  - Eye Point of Regard Measurements

DLR Remote Field-Test-Plattform, Research Airport Braunschweig
Video system for panorama and image processing

Gbit/s - Fibre optic LAN

Experimental Augmented Vision HMI
**Technical Data**

**Cameras:**
4 x (1600x1200), 14bit/pixel, 25 frames/s
PTZ: f = 3.6 – 82.8 mm, 23 fold

**Panorama:**
Wide angle tiled projection with 4x2 SXGA (1280 x 1024)
2 arc min / pixel

**Data Transfer:**
GBit Ethernet, typically 100 MBit/s, MJPEG compressed
Eye Tracking Measurements

- Dwell Time / rel. %
- Eye Tracking: AoI Dwell Times

- a: Weather Display
- b: Control Strips
- c: Far View
- d: Radar Display
- e: Zoom Camera

Graph showing dwell times for different display elements.
RAiCe (2010)  
- first 1 to 2 Multiple Remote Simulation -
RAiCon (2010 - 2012)

- DFS-DLR-Collaboration
- Planning, Development, Set up, implementation and validation of a RTO prototype systems at Airport Erfurt
Field Test Plattform Erfurt

**200° - Camera System:**
5 x (1920x1080), 200° x 66°
12bit/pixel, 30 frames/s

**Pan-Tilt-Zoom (PTZ) - Camera:**
VGA-Resolution
continuous Rotation
23x Zoom, 1.7° - 40° Field of View

**Pan-Tilt-Zoom IR (PTZ) - Camera:**
3 Fields of View (2°, 7° and 21°)
4-5µm MWIR, 640x512pixel,

**Panorama Wall:**
5 HD-LCD – Monitors
2 Wacom – Displays
Visual Resolution 30cm/500m (2 arc min)
Set up of Research Prototype Platform at Erfurt Tower, 2012

Cameras on top of the Tower Erfurt

Technical Test Station Braunschweig

Remote Position Erfurt Tower

WAN-broadcast

50Mbit/sec

Rack room of Tower Erfurt
Panoramic View and PTZ
Gear Down - Mean Plot for Correct Answer with Standard Error (n = 27)

Correct Answers in %

- CWP-remote
- CWP-tower

Distance (NM)

H1 (0.5)  H2 (1.0)  H3 (1.5)
Gear Down - Used Sources of Information for Position CWP-tower (only correct answers)

- H1 (0.5)
- H2 (1.0)
- H3 (1.5)

Distance (NM)

Gear Down - Used Sources of Information for CWP-remote (only correct answers)

- H1 (0.5)
- H2 (1.0)
- H3 (1.5)

Distance (NM)
Static Objects - Used Sources of Information for Position CWP-tower (only correct answers)

Frequency

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<th>Distance</th>
<th>Panorama</th>
<th>Magnification</th>
<th>Panorama and Magnification</th>
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Distance

Static Objects - Used Sources of Information for CWP-remote (only correct answers)

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Distance
DFS Human Factors Studie 1:1 Multiple Remote Conzept

Feasibility Studie & Safety Assessment

Is a controller able to handle traffic via different airports safe and efficiently?
Average workload and traffic load over the time
1:2 Multiple Remote Tower Center Simulation (SESAR, 2013)

Is a controller able to handle traffic simultaneously at two airports safe and efficiently?
Percentage rate of observation of all take-offs and touch downs:

Multiple Remote: 82.7%

Single Remote: 93.2%
Mean Dwellfixes (N=16)

% 50

Out the window  e-strips  Radar  other

MuAd  MuBa  SiBa
Important Results of our Research

• Operational and technical proof of feasibility:
  • Technical Requirements
  • Situational Awareness
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➡️ Proof of principal Feasibility shown!
Remote Tower Community

- Inventor & Patent holder
- Research and Develop.
- Communicator
- System Provider
- ANSPs
- Airports
- Additional Support

Workshops
Veröffentlichungen
Konferenzen

Manufacturer
European Institutions

R&D
User
What is still to be done?

- Multiple Remote Concept Design
- Decision Support Tools
- Fusion with additional sensors
- Certification and Standardisation
- Best HMI Design
Where are we today?

A Vision has become Reality

Most recent Field-Test-Platform, DLR Braunschweig