Virtual Tower
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Airport – Bottleneck or Booster for Future ATM
DLR-Institute of Flight Guidance, Braunschweig, Germany
Tower Control Problems:

Human Computer Interaction: situation awareness / head down times under increasing traffic

Cost… of Tower Building; … of Operator staff for small airports

Safety: Airport - Safety Management System with Replay

Capacity: Weather Dependence

Solution: Sensor Based (Windowless) Control Center with Augmented Vision Video Panorama

Advanced Control Center Simulator (ACCES)
➢ Virtual Tower Study (ViTo: 2002 – 2004)

Requirements & Initial Concept

Augmented Tower Vision

Cognitive Modeling for HMI Design

➢ Remote Tower Operation (RapTOr: 2005-2007)

Work Analysis & Modeling

RTO Experimental Testbed
HCI: Problem of head down times under increasing traffic

Augmented Vision: Integrating Far View and Data for improving Situation Awareness
To meet capacity problems and request of low cost carriers:

Virtual Tower / Remote Tower Operation RTO

ACCES as experimental RTO - HMI
ViTo / RTO – Concept.
Augmented Vision – Video Panorama with integrated Flight Data
- Virtual Tower Study (ViTo: 2002 – 2004)
  - Requirements & Initial Concept
  - Augmented Tower Vision
  - Cognitive Modeling for HMI Design

- Remote Tower Operation (RapTOr: 2005-2007)
  - Work Analysis & Modeling
  - RTO Experimental Testbed
Augmented Tower Vision ATV

reducing head down times and weather dependence

Holographic Transparent Projection: Weather Display TWR Dresden [2003]
Head Down Time Reduction! ⇐
Decrease of Reaction Times!?!⇐

Problems:
Spontaneous Perception Switching
Binocular Rivalry / Cognitive Multistability
[Peli1990][Laramé 2000][USAARL Rep.#2002-2]

⇒ Experiments and Cognitive Models

Augmented Tower Vision

Test of Laser Retinal Scanning Display (RSD) at Frankfurt Airport Tower (2/03).
Augmented Vision Response Times with holographic Projektion Display

Virtual Tower Study (ViTo: 2002 – 2004):

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- Augmented Tower Vision
- Cognitive Modeling for HMI Design

Remote Tower Operation (RapTOr: 2005-2007):

- Work Analysis & Modeling
- RTO Experimental Testbed
[B. Werther, PhD Dissertation 2005]
Ambiguous Visual Stimuli

Cognition based Decision Making

Nonlinear Dynamics Attention - Perception Model
(tool: Matlab – Simulink) [Fürstenau 2002 – 05]
➢ Virtual Tower Study (2002 – 2004):

  Requirements & Initial Concept

  Augmented Tower Vision

  Cognitive Modeling for HMI Design


  Work Analysis & Modeling

  RTO Experimental Testbed
Project RapTOr
2005 - 2007

Work Analysis & Modeling
Augmented Video Panorama Experimental System
Real Time Image Processing
Demonstrator & Final Experiments

Budget: 2.5 M€
Effort: 20 PY
Participation: DLR Inst. of Flight Guidance
Inst. of Traffic Systems
Unit Optical Information Systems
Cooperation: German Air Traffic Control (DFS) / Tower GmbH
(Cognitive) Task & Work Analysis [Vicente 1999]

- Work Domain Analysis
- Control Task Analysis
- Strategy Analysis
- Analysis of Social Organisation und Cooperation
- Operator – Competency Analysis

RTO Controller Workplace within Remote TWR: Augmented Vision Video Panorama

Remote Airport / Controlled Airspace

GBit/s Datalink
Analysis & Design of Information Sources (HMI) using Petri Net Model (Replacement of Far View by Videopanorama & Augmented Vision)

[B.Werther 2005]
Virtual Tower Study (ViTo: 2002 – 2004):

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- Augmented Tower Vision
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Remote Tower Operation (RapTOr: 2005-2007):

- Work Analysis & Modeling
- RTO Experimental Testbed
Augmented Video Panorama System at Braunschweig Airport

- Video system for panorama and image processing
- Gbit/s - Fibre optic LAN
- Experimental Augmented Vision HMI

Wind 6 kt 310° LH089 BA236
High resolution panorama camera system showing section with Braunschweig Tower and west part of airport
RTO visualization: Lab system for hard-/software development & ATV design
RTO Visualisation System with DLR TWR Simulator (6x SXGA(1280x1024))
Control Center Simulator: RTO Panorama Projection (5120 x 2048 Pixel)
Proposed EC Project 2006 – 2008:

- **Industries**
  - SELEX-SISTEMI (AMS, Coordinator) (I)
  - Oerlikon Contraves (I)

- **Universities**
  - Tor Vergata University (I)
  - Genova University (I)

- **Research LABs**
  - DLR (D)
  - FhG-HHI (D)
  - PIT Telecom Res. (PL)
  - SICTA LAB (I)

- **ANSP**
  - ENAV (I)
  - HCAA (GR)

- **SME**
  - ASIS (D)
  - Deep Blue (I)
  - Sector (GR)
  - TAW (I)

**Partners**

**STREP-FP-6 Proposal # 030761**
Effort: 588 PM
Budget: 7.7 MEuro