Remote Tower Operation (RTO) describes the goal of remote control of small airports and of movement areas of large airports which are not directly visible from the control tower. Results of tower work and task analyses exhibit the importance of the direct far view out of the tower windows for establishing the controllers' situation awareness under present day work conditions. This finding provides the motivation for designing a high resolution augmented vision video panorama as main component of the RTO Human Machine Interface (HMI) that replaces the direct far view out of the tower windows.

Fig. 1: Braunschweig Research Airport with main runway in east-west direction. Red lines indicate camera segments of 180° video panorama system; red circle: camera location; red square: visualisation system; yellow lines: fiber-optic high speed data network with thick line indicating Gbit link for panorama video transmission.
Fig. 2: Four remotely controlled high resolution panorama cameras and pan-tilt zoom (PTZ) camera with automatic tracking function. Braunschweig control tower in the background.

In 2005 the DLR project RapTOr (Remote airport Tower Operation research) was started as follow-up of the „Virtual Tower“ concept study (ViTo, 2002 - 2004). Within RapTOr an RTO experimental system is realized as extension of the Advanced Surface Movement Guidance and Control System (A-SMGCS) at the Braunschweig research airport. Analysis, cognitive modelling and simulation of the tower work procedures support the design and development of the demonstrator. RapTOr is the first step on the way to the RTO Center for the control of multiple small airports and to the Virtual Tower (ViTo) control center for large airports as long term goal.

A PC cluster with the image compression software at the camera position allows for storing panorama and zoom data (roughly 40 GByte of data per hour). This feature provides the possibility of complete panorama replay. Figure 3 depicts the live video panorama of the monitor system, with the remotely controlled PTZ-camera displayed on a separate monitor. Interaction of the operator with the panorama system (cameras, weather station, microphone) is performed via pen touch-input display.
Within the videopanorama we integrate real-time aircraft position information obtained from the multilateration system at the (local) Braunschweig airport via transponder. Under reduced visibility this Augmented Tower Vision (ATV) feature allows for localizing the a/c near the correct position because the transponder code, a/c label and numerical information are integrated near the nominal a/c image location in real time. Contours of the movement areas are superimposed on the reconstructed panorama for guiding the operators attention during darkness or bad weather conditions.

One important advantage of the so called video see-through augmented vision technique is the easy integration of augmented vision features into the digital video panorama. This characteristic avoids the problem of (computational) delay between real scene and augmented information of the optical see-through technology as realized with the head – up and head mounted techniques which have been suggested for augmenting the real far view out of the tower windows.

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