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Purpose This work aims to develop a system that enables improved visualization of Architectural Engineering and Construction (AEC) 3D-information for application in design, construction, and management of the built environment. **Method** A novel Augmented Reality (AR) system is presented that uses a single standard digital camera and which, contrary to other investigated approaches[1,2], does not rely on any markers inserted in the scene, nor on any positioning and inertial technologies. The system is solely image-based and consists of two stages. In a first off-line stage, a 3D-map of the scene is automatically constructed from a set of digital images, and the augmenting information (e.g. the 3D-model of the building asset) is subsequently registered with this map. The 3D-map reconstruction employs structure-from-motion techniques with SURF features (the resulting map consisting of a set 3D-referenced SURF-features) followed by a Poisson mesh reconstruction procedure. The next step consists of online operations. The positions of target digital images (e.g. from video stream or head-mounted camera) are automatically calculated, using a robust SURF feature matching procedure that is optimized for three different situations (initialization, tracking, and resetting) implementing octrees for efficient 3D-pruning, and *k*d-trees for efficient feature matching. Once each input image is positioned within the map, the view is augmented. A notable feature of dense mesh scene reconstruction conducted in the present work is that it enables static occlusions of the scene on the augmenting data to be taken into account. **Results & Discussion** Several experiments validate the proposed system and demonstrate its overall performance: a near real-time processing speed, very accurate and stable positioning (*Figure 1*) The limitations of the current system are also discussed including: the currently limited processing speed and the need for adequately textured scenes.

References

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Affiliation: Heriot-Watt University, Edinburgh, UK; *E:* f.n.bosche@hw.ac.uk
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Figure 1. Six of the processed stream images of the EPFL dataset before (lines 1 and 3) and after (lines 2 and 4) being augmented with a Parisian style building.