

### Calibrating an Optical See-Through Rig with Two Non-Overlapping Cameras: the Virtual Camera Framework Jim Braux-Zin<sup>1</sup>, Adrien Bartoli<sup>2</sup>, Romain Dupont<sup>1</sup>, Régis Vinciguerra<sup>1</sup> <sup>1</sup>CEA, LIST <sup>2</sup>ISIT, Université d'Auvergne

### **Context: Optical See-Through Augmented Reality**

Immersive games, marketing, maintenance...



Secure driving assistance, surgery...



Most generic and challenging setup: moving viewer and scene Prototype: screen, two cameras.



# Calibration process

We know:

- Viewer pose: Head Tracking
- Scene pose: SLAM

We still need:

Scene camera pose



The most sensible error to minimize is the percepted alignment error.

- Step 1: A known object is put in front of the system.

- Step 2: The viewer clicks on a set of object points.

- Repeat from other points of view. **GOAL:** minimize the distance between the clicks and the reprojection of the known object.



Scene camera pose

Mapping

Two rotations involved: hard, non convex problem... What if we could get back to a classical problem?

### Introducing our new framework: virtual cameras to the rescue

User inputs User clicks **Optical center** Reprojection of object points into a virtual camera Focal plane

Huge simplification of the problem by allowing the use of proven techniques.

## Classical resectioning of virtual cameras as an initial calibration

**Result: unnoticeable 3mm reprojection error** (with object and viewer one meter from the screen)

Object points are known in the scene camera coordinates. **Direct Linear Transform** [1] is used to estimate the pose of the scene camera.

The other camera can be estimated by symmetry or ICP. A bundle adjustment step refines these estimates.

#### 15x better than mirror-based state-of-the-art[2]

Abdel-Aziz and H. Karara. Direct linear transformation from comparator to object space coordinates in close-range photogrammetry, ASP Symposium on Close-Range Photogrammetry 2] Rodrigues, R., Barreto, J., & Nunes, U. Camera pose estimation using images of planar mirror reflections. ECCV 2010



**Contact:** jim.braux-zin@cea.fr