NAIST® Research Highlights

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Computer vision

Augmented reality zoom now possible

A novel algorithm improves the registration between virtual and real images in dynamic augmented reality

Augmented reality adds computer-generated images, video and sound to our own perception of the world around us. For example, the technology could aid navigation by superimposing street directions onto the view of a user through a head-mounted display. Researchers at Japan's NAIST have now developed a method that enables zooming in augmented-reality systems, making them useful for an even broader range of applications[1].

A common way to implement augmented reality is to overlay virtual information on a camera image and then relay this information to the user through a display device such as glasses or goggles. This 'video see-through' technology requires the computer-generated image to be accurately aligned with the objects in the user's field of view.

> **"Taketomi and co-workers ... have now demonstrated an algorithm that can simultaneously estimate both intrinsic and extrinsic camera parameters during camera zooming."**

One way to perform this geometric registration between real and virtual worlds is to position the artificial image relative to specific markers by using an algorithm that can estimate various operational parameters of the camera. Such parameters can include extrinsic ones, such as position and orientation, and intrinsic ones, such as focal length and lens distortion.

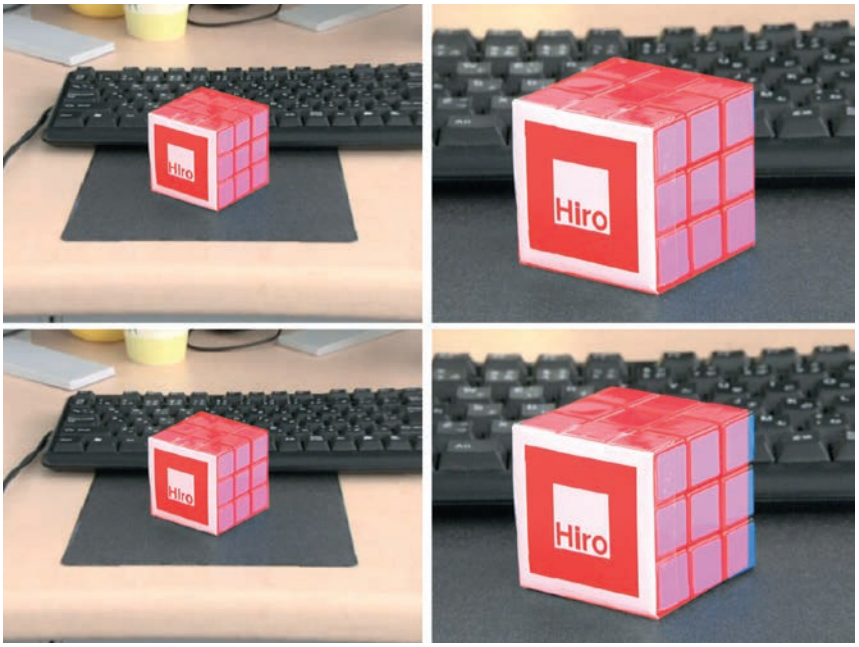
"Many methods for estimating camera pose have been proposed," says NAIST researcher Takafumi Taketomi. "However, these methods assume fixed intrinsic camera parameters, which prevents zooming because the focal length changes depending on zoom values."

Taketomi and co-workers from the NAIST Interactive Media Design Lab together with colleagues from Capcom and the Tokyo Institute of Technology have now demonstrated an algorithm that can simultaneously estimate both intrinsic and extrinsic camera parameters during camera zooming.

The team's scheme starts with a pre-calibration procedure. This involves assessing the intrinsic camera properties at each level of magnification. The calculation then accurately estimates the intrinsic and extrinsic parameters online. This approach uses the conventional marker-based method, but improves it by adding a consideration for reprojection errors and the continuity of zoom values.

The team demonstrated their technique by superimposing a virtual cube on a real Rubik's cube. Whereas a displacement could be seen between the two when zooming in using a traditional camera-parameter estimation technique, far improved alignment was possible using the new scheme (see figure).

Camera zooming is an important technique for video production, and so this method could allow augmented reality to be used in entertainment-industry applications. "Our method is designed for specific cameras at the moment," explains Taketomi. "In the next step, we want to extend this method for more general camera settings, so that it can be applied to mobile devices with a camera and display."



Augmented reality superimposes a virtual cube on a real Rubik's cube. The alignment between the two using the novel scheme (top right) is much improved relative to previous methods (bottom right).

Reference

1. Taketomi, T., Okada, K., Yamamoto, G., Miyazaki, J. & Kato, H. Camera pose estimation under dynamic intrinsic parameter change for augmented reality. *Computers & Graphics* **44**, 11–19 (2014).

More information about the group's research can be found at the Interactive Media Design Laboratory webpage: http://imd.naist.jp/