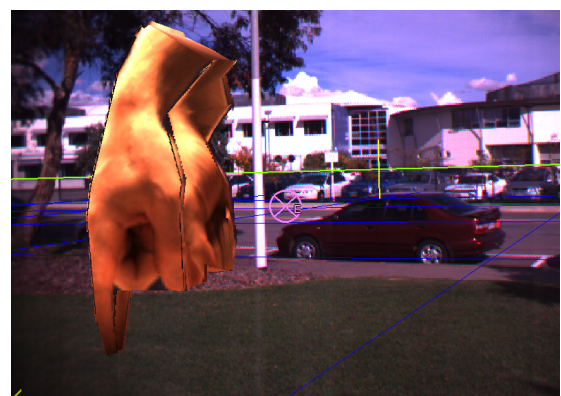
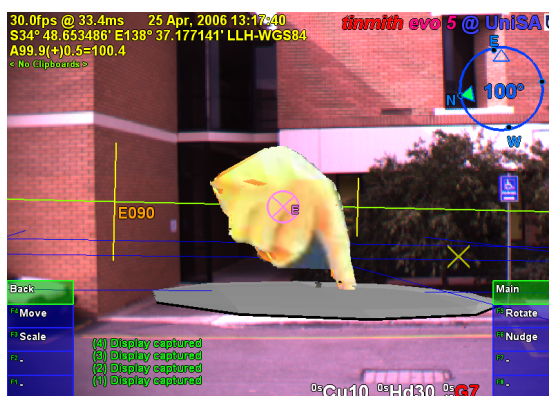


D

Camera quality

The quality of the cameras makes a significant difference to the quality of the reconstruction (see Figure D.1). There are a number of camera attributes that affect the reconstruction output:

- **CCD quality** - A single camera capturing images of a static scene will produce variance in the pixels from one frame to the next. One source of variance is lighting conditions. For example, fluorescent lights flicker at a frequency of 50Hz in Australia and depending on the shutter speed and frame rate this seemingly fast flicker rate can introduce variation in pixel intensity from one frame to the next. Another source of pixel variance is the quality of the Charge-Coupled Device (CCD) and photoelectric light sensors in the camera. Poor



(a) Reconstruction using Fire-i cameras in 320x120. (b) Reconstruction using Point Grey Dragonfly cameras in 640x240.

Figure D.1: Quality of cameras matters.

quality components produce inconsistent pixels values between frames. For 3D capture a camera with little variance improves the background subtraction process.

- **Number of pixels** - The number of pixels a camera can capture affects the quality of the reconstruction, particularly for close up viewing of the reconstruction. With a small number of captured pixels the edges of the reconstructions are clearly jagged. With more pixels the sharp jagged edges are less noticeable. Unfortunately more pixels require more computation. However with increasing graphics processing performed in parallel on the GPU, this is not a considerable problem.
- **Field of view** - The field of view of a camera is directly related to the lens used. Typical off-the-shelf cameras use a lens of around 8mm. In cameras such as the Fire-i this produces a horizontal field of view of around 35 degrees. The Dragonfly cameras have interchangeable lenses. With a 4mm lens the dragonfly cameras have a horizontal field of view of around 70 degrees. This leads to a larger working volume as discussed in Section 4.1.2.1. The 4mm lens on the Dragonfly is able to capture a larger working volume than the 8mm lens on the Fire-i. Therefore, more of the hand and part of the wrist is able to be captured (see Figure D.1). Lenses that produce a wide field of such as the 4mm lens described above also introduce radial lens distortion, the wider the field of view, the more distortion. The radial distortion produced by the 4mm lens is visible but does not adversely affect the quality of the HOG objects and so it is not compensated for in this system.
- **Configurable** - Cameras offer different levels of access to configuration options. Settings such as brightness, gain, exposure time and shutter speed all affect the quality of captured images. Typically these cameras will offer an automatic mode, but to obtain the best results it is still necessary to edit these settings for the particular setup. For example, manually adjusting the shutter speed can eliminate flickering caused by the light sources, most cameras can not automatically compensate for this. Similarly automatic gain and brightness settings can add noise to images as they are electronic manipulations of the original signal. Manually reducing the gain and brightness and setting the shutter speed to increase or decrease the amount of light the CCD receives can produce better pixel colour than typical automatic settings. Many cameras only offer limited access to configuration settings, for example the Unibrain

Fire-i only has 8 discrete shutter settings whereas the dragonfly cameras from Point Grey have over 500 discrete settings. The ability to manipulate these settings impacts on the quality of the captured image. The hand in Figure D.1(a) was captured with a Unibrain Fire-i whereas the hand in Figure D.1(b) was captured with a Point Grey dragonfly camera. The second image clearly has richer colours than the first and this is largely due to flexibility of the settings in the dragonfly cameras. It is possible that the Fire-i cameras have a poorer quality CCD but without the ability to perform fine grain manipulation of the settings it is difficult to determine.