Real-Virtual Antialiasing

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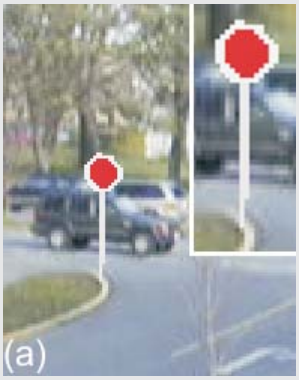
Abstract

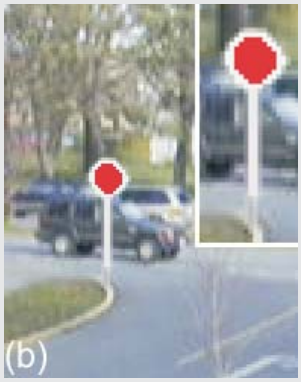
The integration of virtual renderings into video images is of great importance for many applications of computer graphics such as TV and movie production and augmented reality. The work described in this poster aims at examining methods for a smooth transition from real to virtual image regions along the boundaries of graphical objects. This constitutes a special form of antialiasing, which works with a set of input data different from its counterpart in purely virtual images. The input data are existing video frames or photos, often at a low resolution, and 3D models describing additional virtual objects. In this poster, the concept of real-virtual supersampling is introduced, which is based on the combination of a high-resolution rendering of the graphical elements and an upsampled version of the video image. Several different methods for image upsampling are discussed. We compare results obtained through these methods with simple image combination methods: image overlay without antialiasing and pixel averaging in the original image resolution.

Example Images

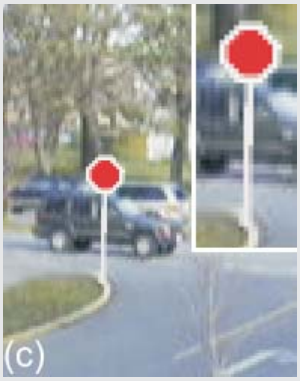
These images show a computer-generated stop sign rendered over a real video frame. Fig. 1(b) shows a comparison image created by averaging border pixels with neighboring pixels in the original image resolution. The images show a portion of the entire composited video frame, with a magnified detail shown in the upper right corner.



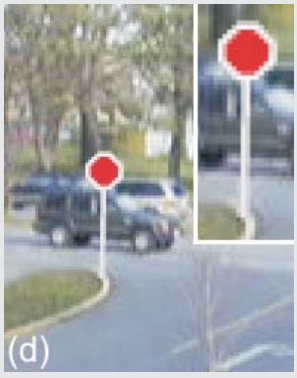
Standard image composition (no antialiasing)



Pixel averaging in the original video resolution



2x real-virtual supersampling

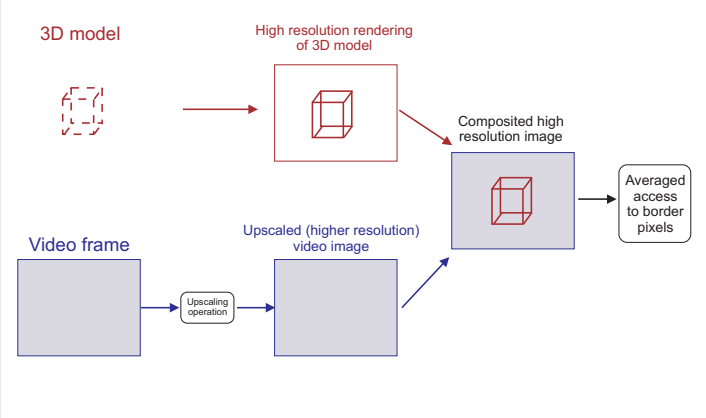


4x real-virtual supersampling

Figure 1

Real-Virtual Supersampling

The combination of real and virtual image elements is for instance essential in TV and movie production, as well as in augmented reality applications. In many cases, graphical models are superimposed over the real image with straightforward rendering methods. This leads to aliasing at the boundaries between real and virtual image regions, as illustrated in Fig. 1(a). Unless image postprocessing filters are applied (e.g., superimposed atmospheric effects), this aliasing can diminish the quality of the visual integration of virtual objects into captured video sequences. This is particularly true if the capturing or display devices do not offer high image resolutions. The work presented here deals with automatic real-time antialising at the boundary between real and virtual image regions. Real-virtual supersampling is enabled by upsampling the real video image and rendering a high resolution version of the virtual content over it. This results in a combined high resolution image, which is used as input for the final image composition step. In the image composition step, camera image and virtual object are rendered at the original, smaller resolution. Only for pixels at the boundary between real and virtual image regions, the high resolution image is accessed, and the pixel colors at the corresponding location are averaged. The averaged high resolution pixels are used as boundary pixels for the combined image, which leads to an antialiased output (see Fig. 1 (c),(d)).



GPU-based Image Upscaling

Several different image upscaling methods were implemented for real-virtual supersampling. Straightforward sample-and-hold (nearest neighbor) interpolation, biquadratic B-Spline interpolation, and a more complex adaptive edge-directed upscaling scheme were investigated. The GPU-based edge-directed upscaling method was implemented based on principles described in [Kraus et al. 2007]. The implementations of these methods are capable of delivering real-time frame rates. Currently, a method for a quantitative evaluation of the comparative image quality of different antialiasing methods is being developed.

[Kraus et al. 2007] KRAUS, M., EISSELE, M., AND STRENGERT, M. 2007. GPU-Based Edge-Directed Image Interpolation. In Proc. of SCIA.

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